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INTERNATIONAL CONFERENCE ICMST 2021 on Maritime Science and Technology

PROCEEDING

ICMST 2021

INDONESIA NAVAL TECHNOLOGY COLLEGE

INTERNATIONAL CONFERENCE ON MARITIME SCIENCE AND TECHNOLOGY

The 5th ICMST - STTAL

FIELD :

1. Operation Research.
2. Logistics Management.
3. Policy and Strategy.

SURABAYA May 27th , 2021

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PROCEEDING

INDONESIA NAVAL TECHNOLOGY COLLEGE
POSTGRADUATE INTERNATIONAL CONFERENCE

"The 5th International Conference on Maritime Science and Technology"

Field :

1. **Operation Research.**
2. **Logistics Management.**
3. **Policy and Strategy.**

SURABAYA May 27th , 2021

POSTGRADUATE STUDIES PROGRAM
INDONESIA NAVAL TECHNOLOGY COLLEGE STTAL

Proceeding

Indonesia Naval Technology College
Postgraduate International Conference

International Conference on Maritime Science and Technology
ICMST 2021

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PREFACE

Dear Authors,
Congratulations on the acceptance of your paper, And thank you for your interest in Postgraduate International Conference, Indonesia Naval Technology College STTAL 2021.

On behalf of the Conference Committee, We would like to formally invite you to attend The STTAL Postgraduate International Conference on Maritime Science and Technology ICMST 2021 on Thursday, May 27th 2021.

The aim of this international conference is to provide a platform to academics, scholars, researchers and practitioners to present and disseminate the latest innovative ideas, research results, and findings on various aspects of Maritime and Management Science. Presenters will be given the opportunity to have their submissions included in the on-line conference proceedings.

Attendees include educators, students, academic managers, quality assurance and educational system leaders, and researchers. We welcome as many attendees as possible.

We look forward to meeting you on 27th 2022.

Surabaya May 27th, 2021
Chairman of Commite,

Dr. Sutrisno, M.T.
Captain Navy


STTAL Postgraduate's
The 5th International Conference
on Maritime Science and Technology
"Empowering a Sustainable Maritime Strategic Development through Research, Innovation and Science"
27th May 2021
Keynote Speakers:
Admiral Yudo Margono, S.E., M.M. (Chief of Staff of IDN)
And
Professor Jeffrey Kline (Maritime Defence & Security Expert, NPS)
Professor Paul Maddison (Director of Defence Research Institute, UNSW)
Professor Bambang Riyanto T. (Control System & AUV Expert, ITB)
Dr. Eng. Miftakhul Huda, M.Sc. (Nano-tech & Solar-cell Expert, NU Japan)
Call for paper in the fields of:
1. Operation Research
2. Logistics Management
3. Policy and Strategy
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SCEDHULE

International Conference on Maritime Science and Technology
ICMST 2021

Held in STTAL Surabaya, Bumimoro-Morokrembangan, : On Thursday, May 27th 2021

WEBSITE : http://www.seminarpasca-sttal.ac.id/

06.30 - 07.00	Opening Remark
07.10 - 07.15	National Anthem "Indonesia Raya"
07.15 - 07.17	Opening Prayer
07.17 - 07.20	Photo Sesion
07.20 - 07.30	Executive Remarks by Commander of STTAL
07.30 - 08.00	Keynote Speaker by Chief of Staff on the Indonesian Navy
08.00 – 11.20	**International Conference** / **Seminary** **Speaker I** : Professor Jefrey Kline (Security and Maritime Defence Expert – NPS USA) **Speaker II** : Professor Paul Maddison (Director Of Defence Research Instiute – UNSW) **Speaker III** : Professor Bambang Riyanto T. (AUV and control System Expert – ITB) **Speaker IV** : Dr. Eng. Miftakhul Huda, M.Sc. (Nano-Tech and Solar-Cell Expert – NU Japan)
11.20 - 12.30	Break
12.30 - 17.00	**Per-Room Seminary,** Presentation by Lecturers & students who send papers, include: **Room I.** *Operation Research Field* **Room II.** *Logistics Management Field* **Room III.** *Policy And Strategy Field*
17.00 – 17.15	Symbolic Delivery of Certificates and Closing

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FIELD II : LOGISTICS MANAGEMENT

FIELD III : POLICY AND STRATEGY

SPEAKER 1

NAVAL POSTGRADUATE SCHOOL

NAVAL WARFARE STUDIES INSTITUTE

Use of Analysis in Maritime Security

Jeff Kline, Captain, USN (ret)
Professor of Practice, Operations Research
Naval Postgraduate School Monterey,
California USA

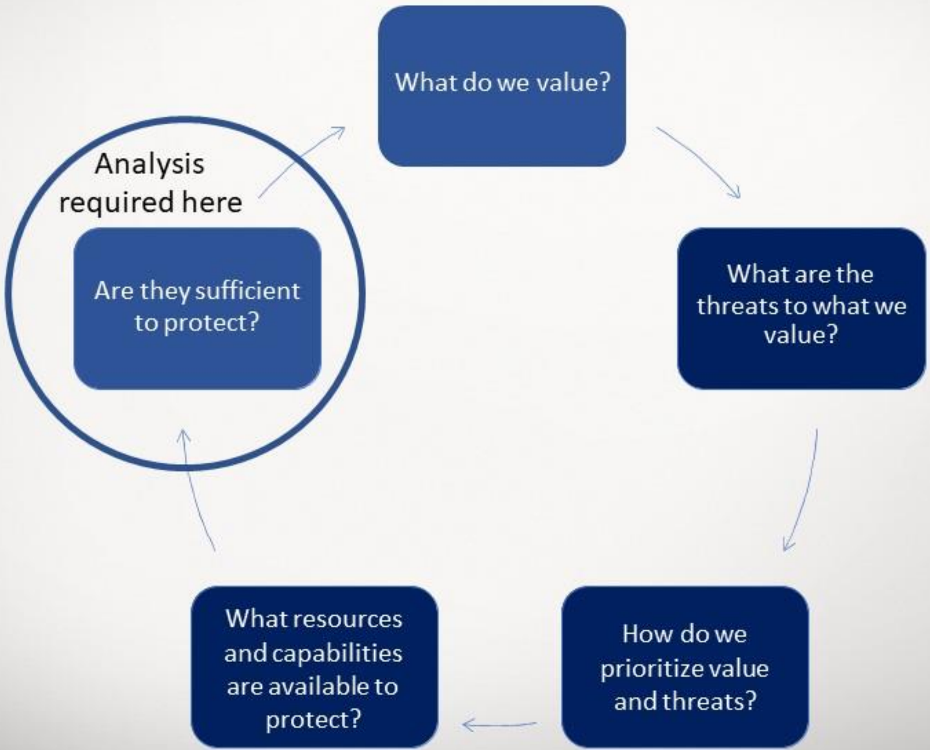
For 5th International Conference on Maritime Science and Technology

- Provide how analyses assist in:
  - highlighting key maritime resources required,
  - understanding maritime asset capabilities,
  - and see how best to employ them.

- With the intent to inform development of policies on:
  - Establishing prioritize objectives
  - Provide scarce resource allocation and
  - Assess progress toward meeting objectives

- Force structure development (future)
  - Mission identification (wargaming, campaign analysis)
  - Gaps analysis (wargaming, modeling and simulation)
  - Assessing alternatives for air, sea, and undersea capabilities (modling and simulation)

- Force employment (present)
  - Best allocation of current forces
  - Risk assessment



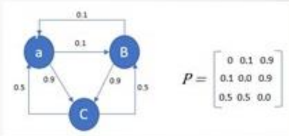
Risk Assessment: How much is enough?

But how do we assess if we have sufficient forces?
How do we identify "gaps" in capability?

- Metrics for maritime security can be threat based or capability based
- Example Threat based example:
  - # of incursions intercepted
  - Probability of Raid annihilation
- Example Capabilities based examples:
  - # square nautical miles searched
  - Response time coverage
  - # of platforms available

Metrics may be used for planning and monitoring

- War Gaming (Generating/Assessing concepts)
- Analytical Models



  - Search Theory
  - Queuing, Markov chains, and combat models
  - Optimization
- Simulation
  - Probability risk assessments
  - Performance exploration
  - Relationships (Systems Dynamics)

From Search Theory

- Total Coverage = wvt/A — Optimistic
- Inverse Cube Law (Two Sensors) — In-between
- Random Search= $1\text{-}e^{-wvt/A}$ — Conservative

w=sensor's sweep width v=sensor's velocity t=search time
A=Search Area

Random assumes "random" movements by searcher and target in a given area.

For example....

Suppose we have an airborne sensor with a sweep width of .1 nautical mile at operating altitude. Its operating speed is 90 Knots and the area you desire it to cover is 50 NMS^2. If your calculated time over the search area is 1.5 hours, what is your "random search" estimate for having the target within the sensors range?

Coverage factor = wvt/A = (.1)(90)(1.5)/50 = .27

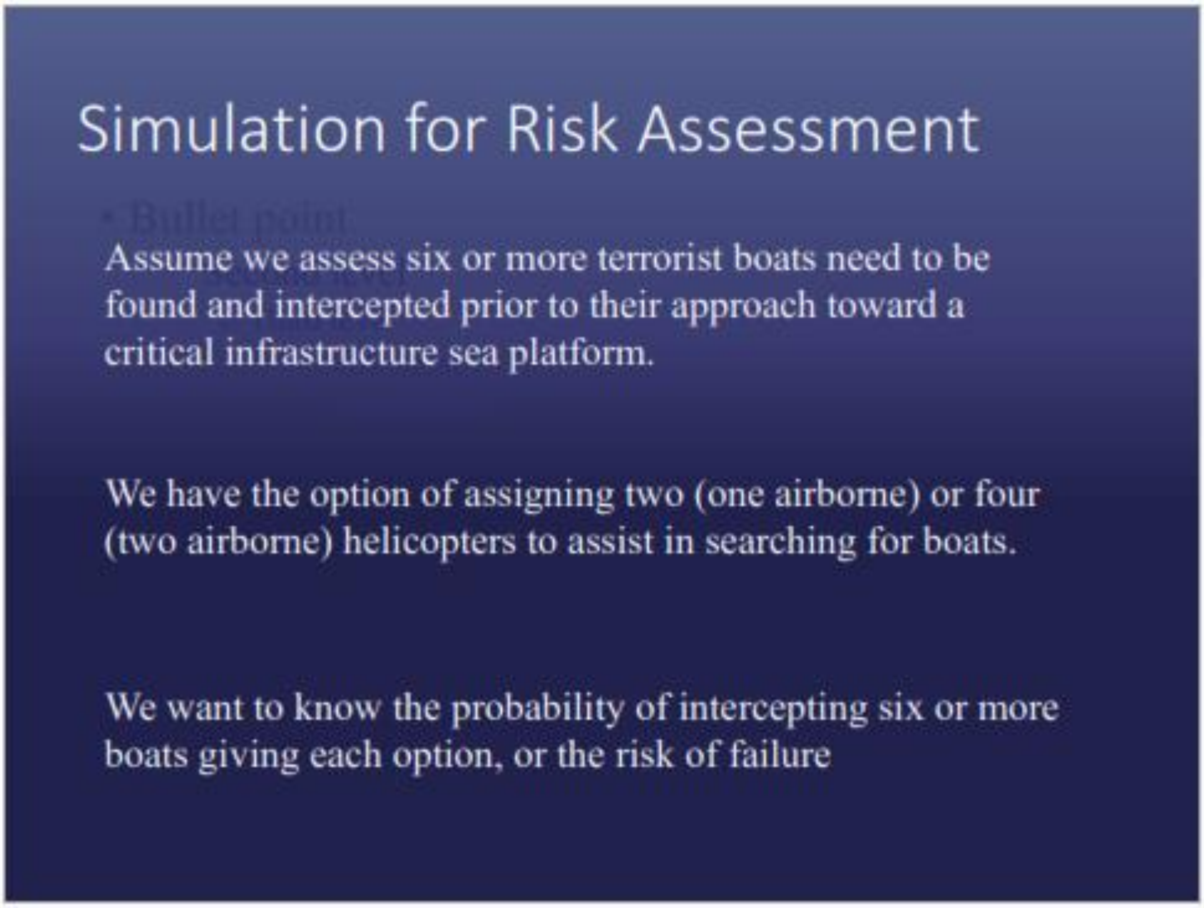
Random Search = $1-e^{-.27}$ = .24

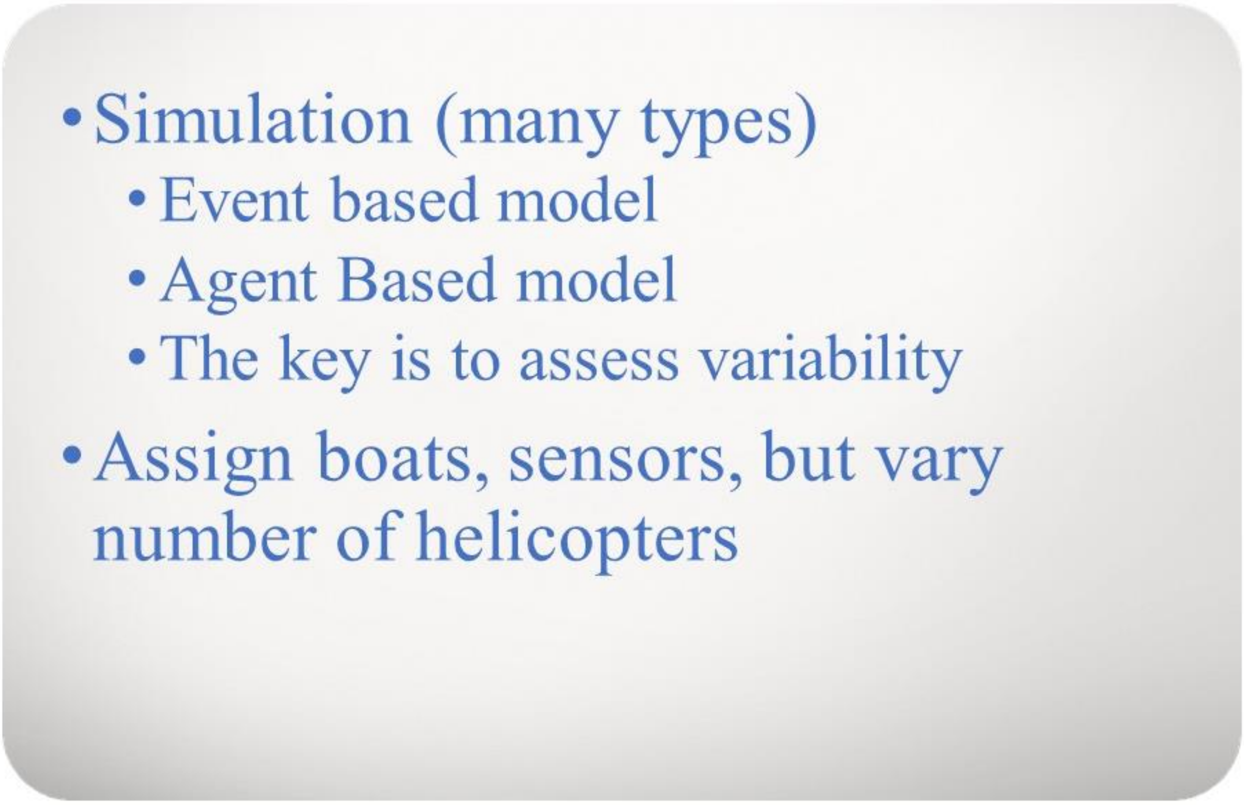
Hmmm...Maybe we need more assets.....

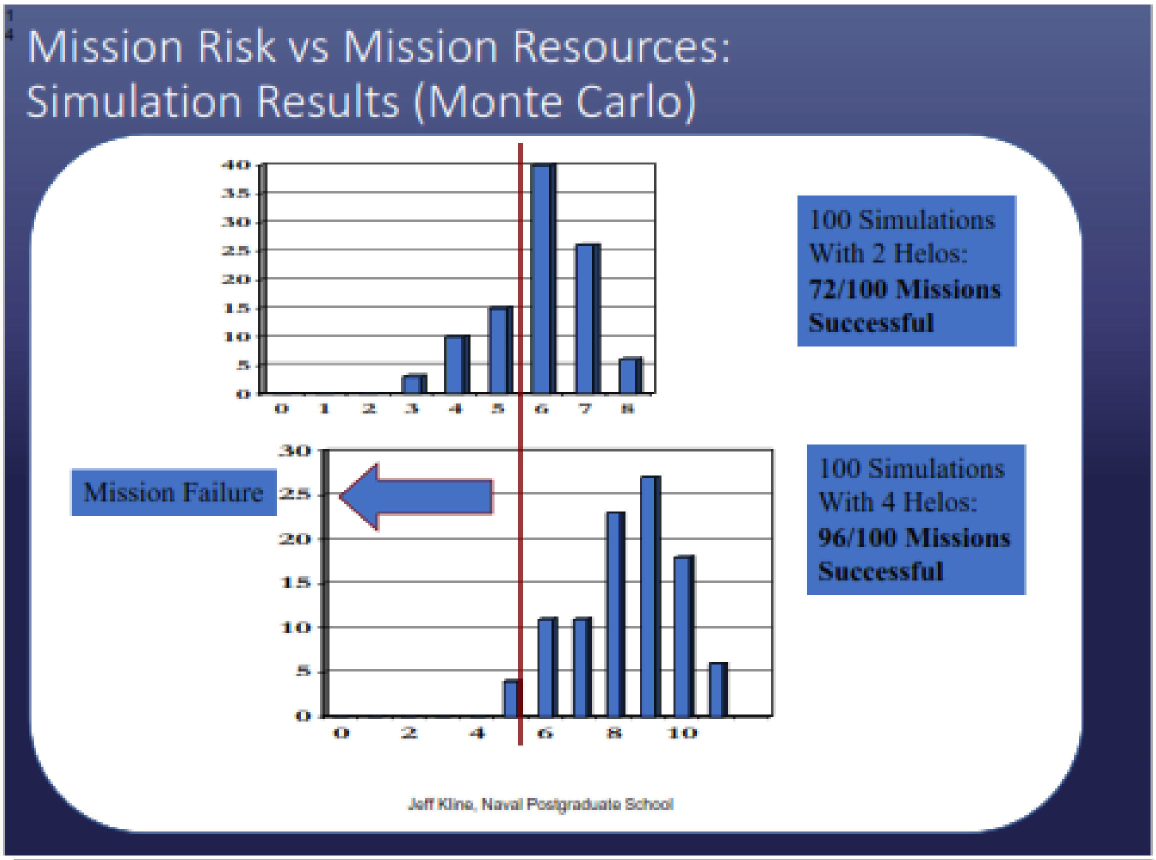
Other Search models

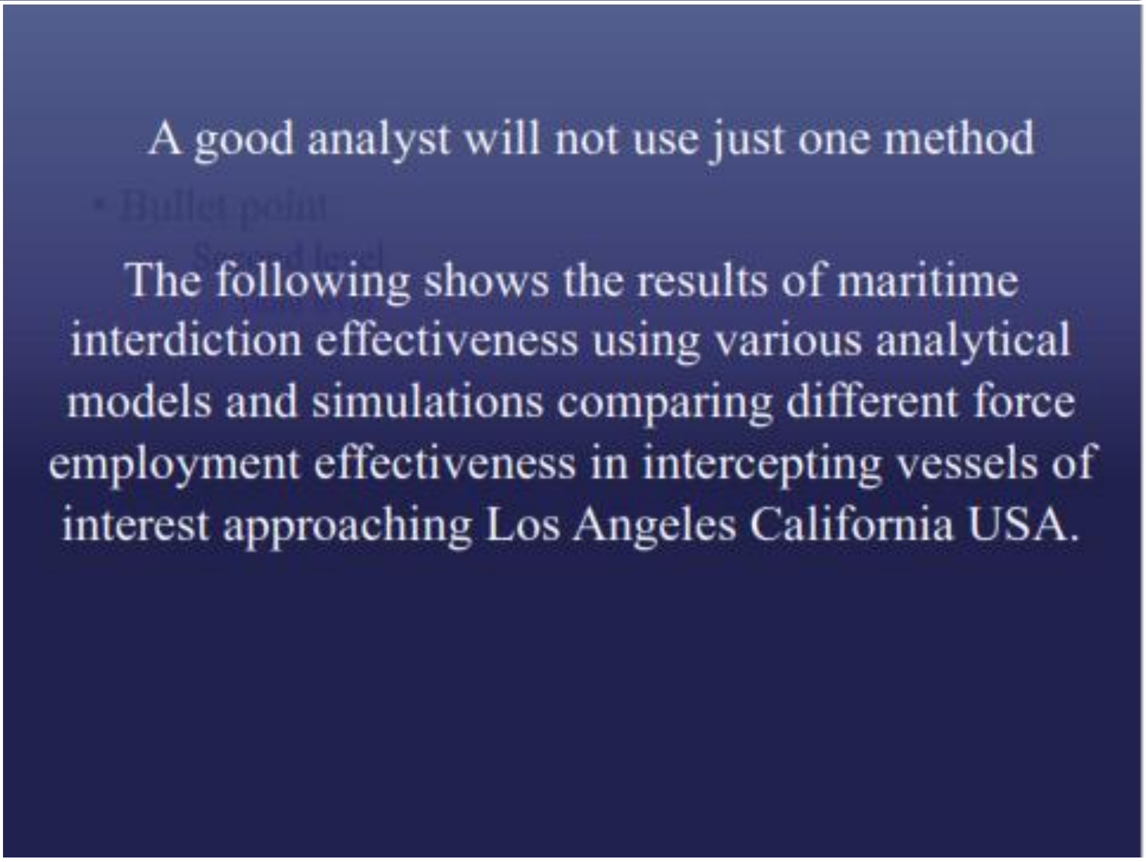
- Linear Barrier Search $P_d \approx \min\left\{1, \frac{w}{d}\sqrt{1+\left(\frac{v}{u}\right)^2}\right\}$
- Fleeing Target $Fd(t) = 1 - e^{-\omega vt/\pi r(r+ut)}$
- Negative Search Re-assignment $T = -\frac{1}{b}\ln\left(\frac{p(c_2)}{p(c_1)}\right)$

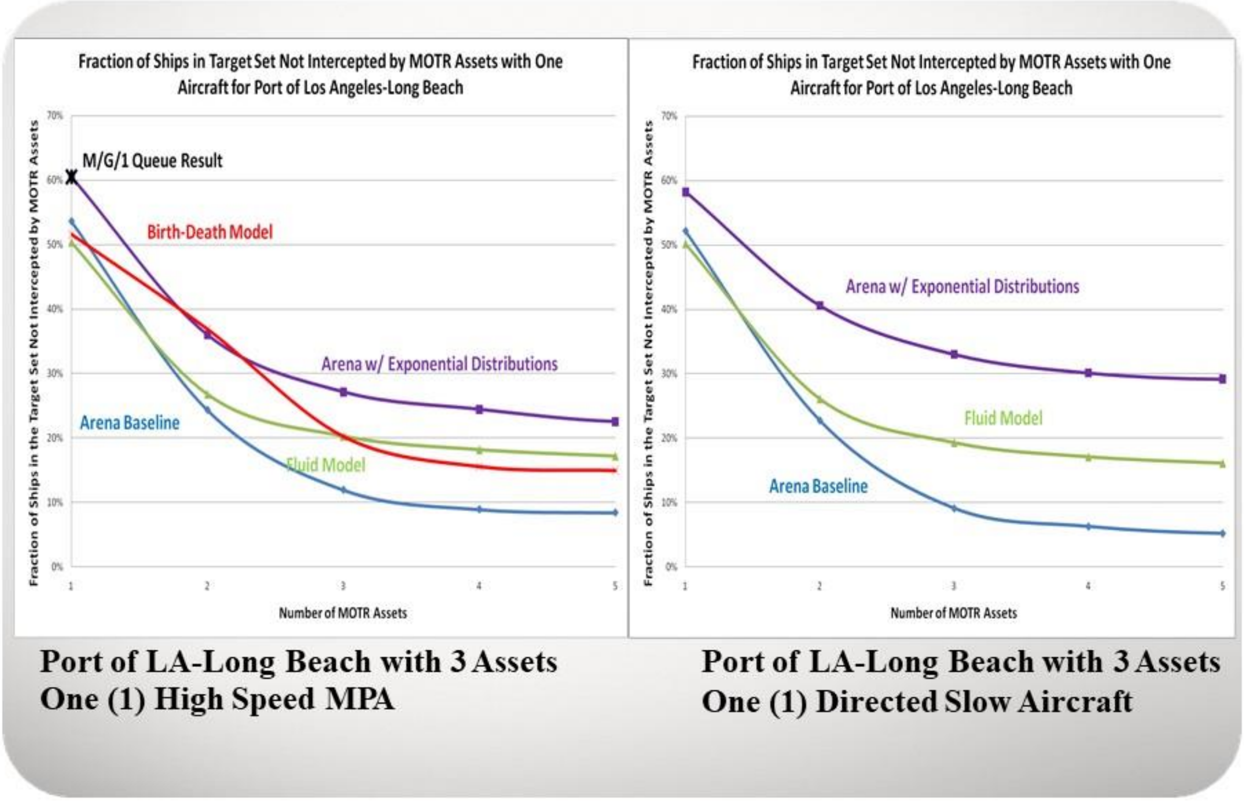
Where w = sweep width d = barrier length v = sensor's speed u= target speed t= search time or search time before moving to new area, r = u x time to get to search area, β= wv/(Area of first cell searched), and p(Cx)= apriori likelihood target is in cell x


Simulation for Risk Assessment
Assume we assess six or more terrorist boats need to be found and intercepted prior to their approach toward a critical infrastructure sea platform.
We have the option of assigning two (one airborne) or four (two airborne) helicopters to assist in searching for boats.
We want to know the probability of intercepting six or more boats giving each option, or the risk of failure

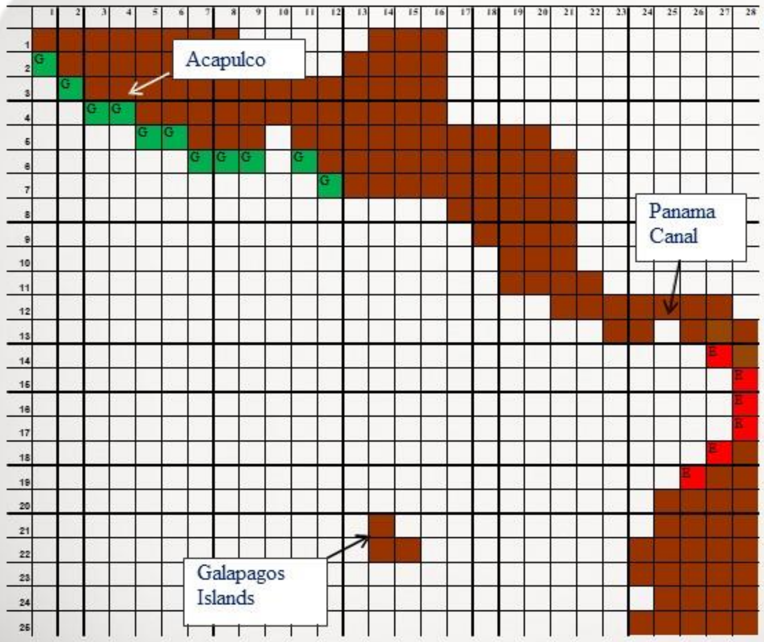

• Simulation (many types)
• Event based model
• Agent Based model
• The key is to assess variability
• Assign boats, sensors, but vary number of helicopters


Mission Risk vs Mission Resources:
Simulation Results (Monte Carlo)
100 Simulations With 2 Helos: 72/100 Missions Successful
Mission Failure
100 Simulations With 4 Helos: 96/100 Missions Successful
Jeff Kline, Naval Postgraduate School


A good analyst will not use just one method
The following shows the results of maritime interdiction effectiveness using various analytical models and simulations comparing different force employment effectiveness in intercepting vessels of interest approaching Los Angeles California USA.


Fraction of Ships in Target Set Not Intercepted by MOTR Assets with One Aircraft for Port of Los Angeles-Long Beach
Fraction of Ships in the Target Set Not Intercepted by MOTR Assets
Number of MOTR Assets
M/G/1 Queue Result
Birth-Death Model
Arena w/ Exponential Distributions
Arena Baseline
Fluid Model
Port of LA-Long Beach with 3 Assets
One (1) High Speed MPA
Fraction of Ships in Target Set Not Intercepted by MOTR Assets with One Aircraft for Port of Los Angeles-Long Beach
Fraction of Ships in the Target Set Not Intercepted by MOTR Assets
Number of MOTR Assets
Arena w/ Exponential Distributions
Fluid Model
Arena Baseline
Port of LA-Long Beach with 3 Assets
One (1) Directed Slow Aircraft

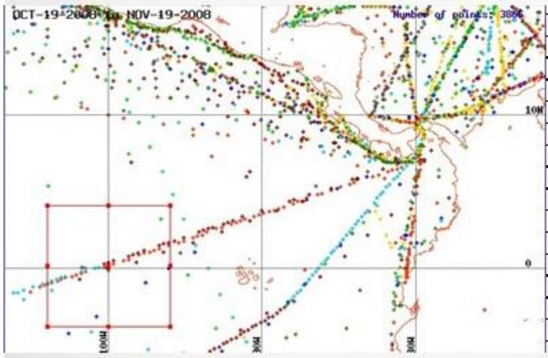

OPTIMIZING EMPLOYMENT OF SEARCH PLATFORMS TO COUNTERING SELF-PROPELLED SEMI-SUBMERSIBLES
CDR Dan "Barney" Pfeiff
Use of Optimization



Each square is a 60X60nm cell

- SPSS operator
  - "Attacker"
  - Must choose transit path from west coast of Colombia (marked "E") to waters off Mexico (marked "G")
- Search platform operator
  - "Defender"
  - Must choose best use of search platforms to detect and classify SPSS
    - Position
    - Spread of search effort
  - Has no intel other than attacker entry and goal cells

Platform type	Max number of cells	Classification Probability (Varies by Shipping Density)	Speed (knots)	Sweep width(nm)	Sweep width depends on
MPA	10	0.95-0.80	180	0-17.4	wind speed
AEW	10	0.5-0.1	180	0-43.5	wind speed
Frigate	3	0.95-0.80	10	10-30	wind speed, water depth, shipping density
Submarine	3	0.5-0.1	10	10-30	wind speed, water depth, shipping density
Seaweb	1 (per sensor)	0.5-0.1	6 (SPSS speed)	0-37 (per sensor)	water depth



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2	2	X	X	X	X	X	X	X					X	X	X	X												
3	1	2	X	X	X	X	X	X	X	X	X	X	X	X	X	X												
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17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	2	1	1	2	1	1	X
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25	10	15	15	15	15	10	10	15	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	X	X	X	X	X

Numerical Assignment	**1**	**2**	**3**
Shipping Density	low	moderate	high
Wind	<10 knots	10-20 knots	>20 knots
Water Depth	>5000 ft	1000-5000 ft	<1000 ft

Totals	3-5	6-7	8-9
Acoustic Conditions	Good	Moderate	Poor

- Shows combination of shipping density, wind and water depth
- Green easy to search, red hard

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
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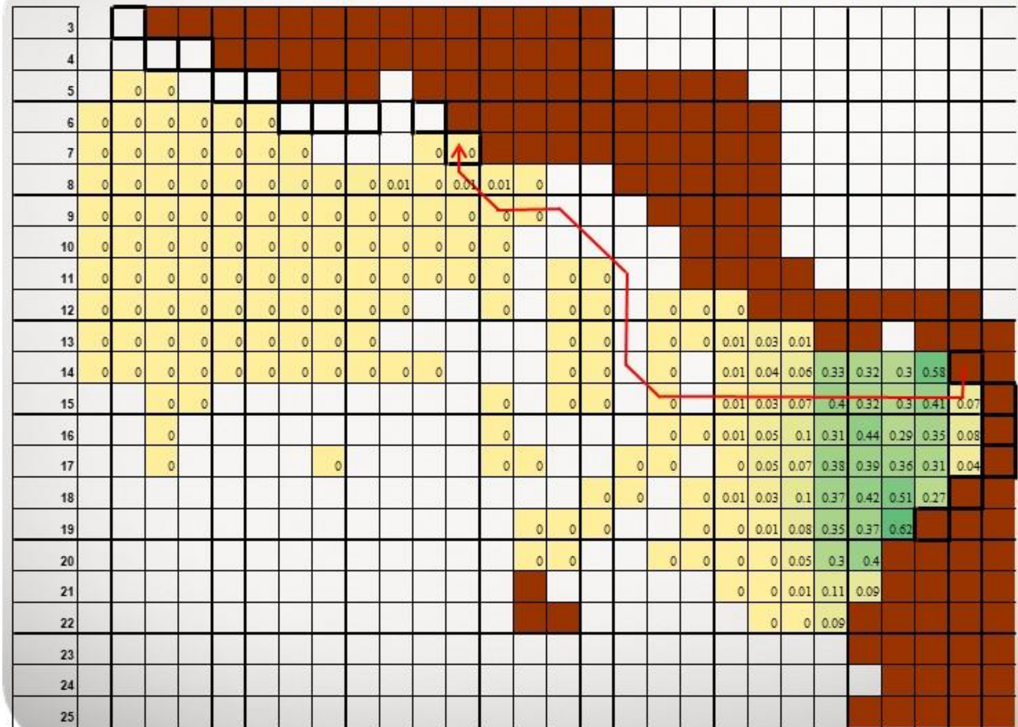
18	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	3	3	3	3	3	4	3	3	3	4	5	X	X
19	3	3	3	3	3	3	3	3	3	4	4	4	3	3	3	3	3	3	3	3	4	3	3	4	3	X	X	X
20	3	3	3	3	3	3	4	4	4	3	3	3	3	3	3	3	3	3	3	4	3	3	3	5	X	X	X	X
21	3	3	3	4	4	4	3	3	3	3	3	3	3	X	5	3	3	3	4	3	3	3	3	5	X	X	X	X
22	3	4	4	3	3	3	3	3	3	3	3	3	4	X	X	6	3	4	3	3	3	3	5	X	X	X	X	X
23	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	X	X	X	X	X
24	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3	4	X	X	X	X
25	3	4	4	4	4	3	3	4	3	3	3	3	3	4	4	3	3	3	3	3	3	3	3	X	X	X	X	X

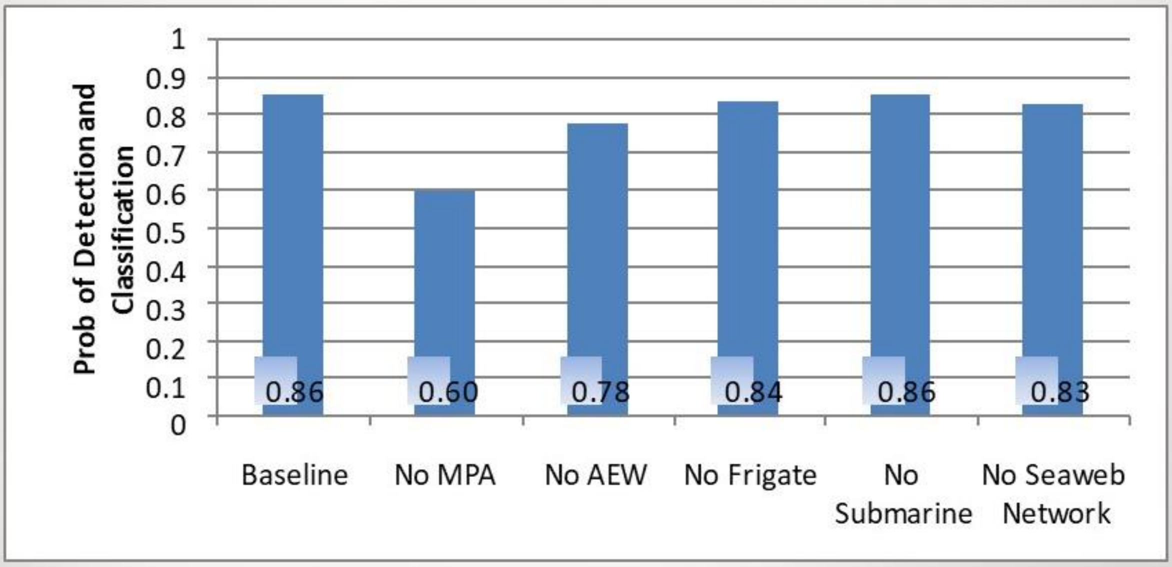
- Given defender search plan attacker chooses path that maximizes evasion probability
  - "Shortest path" problem

- Given attacker path defender chooses search plan that minimizes evasion probability
  - Shortest path interdiction problem
  - Defender interdicts the path by choosing platform missions (sets of cells)

For another example see "A Two Sided Optimization for Theater Ballistic and Missile Defense" Brown, Diehl, Kline and Wood, 2005
https://pubsonline.informs.org/doi/abs/10.1287/opre.1050.0231

Probability of detection and classification 0.86

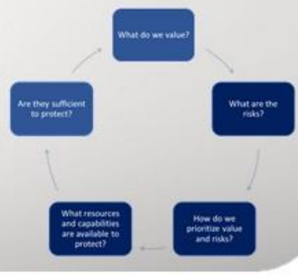




Many other tools, but remember, it's not about the tool, but the problem. What will provide us relevant information to make a decision?

Analysis in maritime security:

- Provides structure method for force planning
- Help identify gaps for force structure procurement
- Helps to employ forces to minimize risk
- Creates metrics for planning and monitori



- Wagner, D.H., Mylander, W.C., Sanders, T.J., *Naval Operations Analysis, 3rd ed*. Annapolis, MD., Naval Institute Press
- Washburn, Alan, *Search and Detection, 4th ed.,* Linthicum, MD., Institute for Operations Research and Management Science Press
- Preiff, D.M., "Optimizing employment of search platforms to counter self-propelled semi-submersibles", MSOR Thesis, Naval Postgraduate School, 2009

SPEAKER 2

University of New South Wales Defence Research Institute

5th International Conference on Maritime Science & Technology

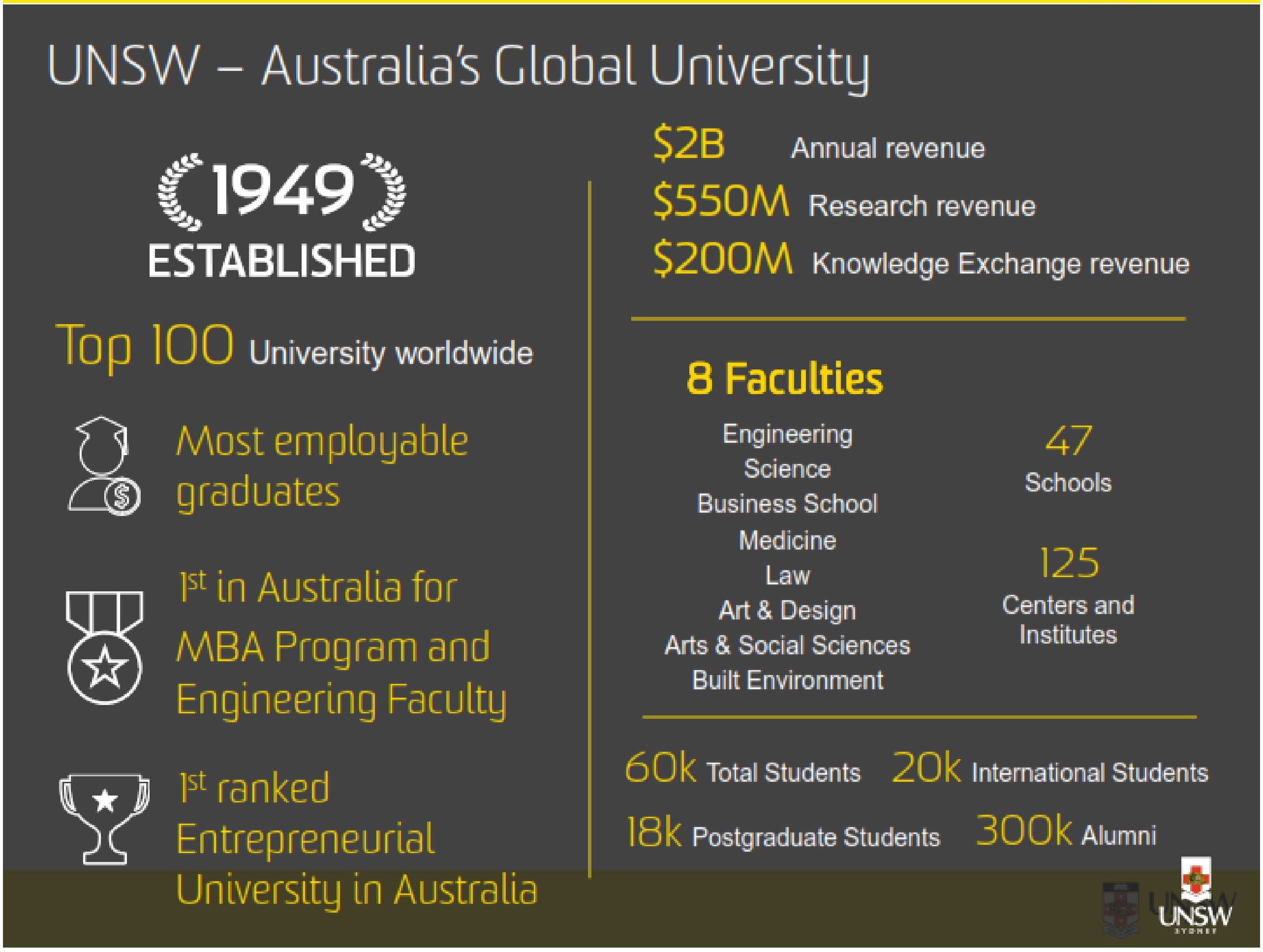
Professor Paul Maddison
Vice Admiral (Ret'd) RCN
Director

27 May 2021

Defence research as an instrument of national power

- Introduction
- UNSW History
- UNSW Defence Research Institute
- Indo-Pacific Geostrategic Context 2020
- Australian Defence Policy
    - STaR Shots
- UNSW Defence Research and Capability Portfolio
- Conclusion / Q&A


University of New South Wales (UNSW)
Australia's Global University
UNSW Vision
UNSW aspires to be Australia's global university, improving and transforming lives through excellence in research, outstanding education and a commitment to advancing a just society.
UNSW


UNSW – Australia's Global University
1949
ESTABLISHED
Top 100 University worldwide
Most employable graduates
1st in Australia for MBA Program and Engineering Faculty
1st ranked Entrepreneurial University in Australia
$2B Annual revenue
$550M Research revenue
$200M Knowledge Exchange revenue
8 Faculties
Engineering
Science
Business School
Medicine
Law
Art & Design
Arts & Social Sciences
Built Environment
47 Schools
125 Centers and Institutes
60k Total Students
20k International Students
18k Postgraduate Students
300k Alumni
UNSW

UNSW Canberra & the Australian Defence Force Academy

UNSW Canberra Campus

ADF Headquarters

Four Schools

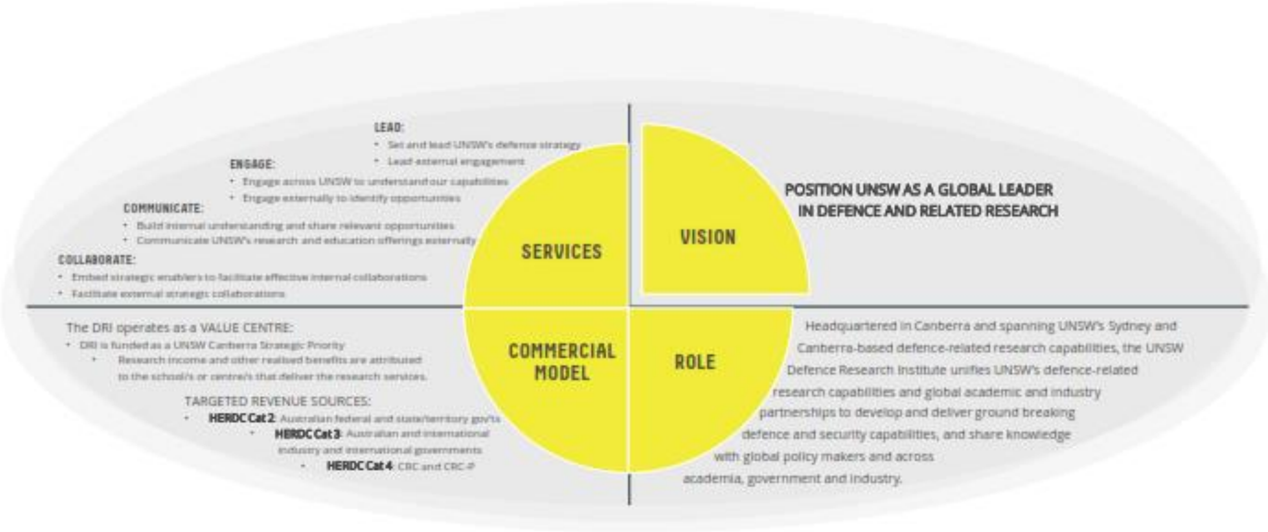
- Engineering & IT
- Science
- Business
- Humanities & Social Sciences

UNSW Defence Research Strengths

BUSINESS	Governance | Leadership | Decision-making and strategy | Migration and development | Program and project management
SCIENCE	Quantum computing and communications | Condensed matter physics | Experimental chemistry | Applied and industrial mathematics | Astrophysics | Cultural and environmental geography
SPACE	Space engineering | Space situational awareness | Advanced instrumentation | Satellite formation flying | Law and ethics
INFORMATION SCIENCES	Cyber security and operations | Information Warfare | Cyber strategy, law and ethics | Complex systems security
AI AND TRUSTED AUTONOMY	AI | Autonomous systems | Machine learning | Computational intelligence | Human-machine teaming | Image processing
HYPERSONICS	Supersonic ignition systems | Hypersonic flight | Measurement and instrumentation | Structure and material testing
HUMANITIES AND SOCIAL SCIENCES	Future operations | Conflict and society | Maritime security | Environment and governance | International law and ethics | Regional and Global and Security

UNSW DEFENCE RESEARCH INSTITUTE

UNSW Defence Research Institute's Role



Operating Model

UNSW works with academia, industry and government partners from across the country and across sectors to equip Australian and allied servicemen and servicewomen to meet the demands of a constantly changing security environment, and to translate world-class research into defence capabilities.

TRL: Technology Readiness Level – a system used to describe the maturity level of a particular technology.

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Indo-Pacific Geostrategic Context

Australian Defence Policy 2020-2030


Defence Science Technology and Research Shots:
Eight STaR Shots (1-4)
Resilient multi-mission space
1
CONTEXT
Space is vital to Defence operations. As the barriers to operating in space are lowered, adversaries are seeking to limit the military advantage provided by space-based capabilities.
CHALLENGE
Assure access to space-based services within a congested and contested space environment, delivered direct to Defence users and coalition partners.
Sponsor: Chief of Air Force
DSTG Chief: Chief of Intelligence, Surveillance and Space Division
Information warfare
2
CONTEXT
Our social, commercial, civilian and military systems are completely dependent on information environments that are highly contested by a range of actors from criminals to nation states.
CHALLENGE
Deliver integrated information warfare capabilities to enable Defence to fight in and operate through contested information environments.
Sponsor: Chief of Joint Capabilities
DSTG Chief: Chief of Cyber and Electronic Warfare Division
Agile command and control
3
CONTEXT
Joint all-domain operations are the new reality in modern warfare where high-speed, high-manoeuvre concurrent operations are conducted at an unmatched tempo.
CHALLENGE
Connect, synchronise and integrate capabilities across multiple domains, multiple services and with a variety of partner nations to understand, shape and dominate the future battlespace.
Sponsor: Chief of Joint Operations & Chief of Joint Capabilities
DSTG Chief: Chief of Joint and Operations Analysis Division
Quantum assured position, navigation and timing
4
CONTEXT
The core reliance of military systems on the Global Positioning System (GPS) is a critical vulnerability.
CHALLENGE
Assure uninterrupted operations in complex and contested environments where access to Global Navigation Satellite Systems (GNSS) is compromised, degraded or denied.
Sponsor: Chief of Joint Capabilities
DSTG Chief: Chief of Cyber and Electronic Warfare Division


Defence Science Technology and Research Shots:
Eight STaR Shots (5-8)
Disruptive weapon effects
5
CONTEXT
The emergence of new advanced and unconventional weapon systems is transforming the battlefield and disrupting the way we influence, deter, deny, fight and win.
CHALLENGE
Deliver precise weapon effects with low collateral damage to control the battlespace, enable freedom of manoeuvre and survive multi-domain combat in highly contested environments.
Sponsor: Vice Chief of the Defence Force
DSTG Chief: Chief of Weapons and Combat Systems Division
Operating in CBRN environments
6
CONTEXT
The threat of Chemical, Biological, Radiological and Nuclear (CBRN) attacks against military and civilian populations is growing as state and non-state actors are increasingly willing to resort to these indiscriminate methods and CBR agent synthesis manufacturing processes are proliferating.
CHALLENGE
Safely and effectively operate within CBRN contaminated environments for prolonged periods of time.
Sponsor: Chief of Army
DSTG Chief: Chief of Land Division
Battle-ready platforms
7
CONTEXT
The ability of a nation to commit to a war and endure a campaign of protracted battles depends on the availability, preparedness and sustainability of its warfighting machines.
CHALLENGE
Maintain sustained presence and battle-readiness to enable high-tempo operations for extended periods of time.
Sponsor: Chief of Navy & Chief of Air Force
DSTG Chief: Chief of Aerospace Division
Remote undersea surveillance
8
CONTEXT
Situational awareness of Australia's maritime interests is essential to meeting Australian Defence Force operational demands across the spectrum of Navy supported tasks.
CHALLENGE
Maintain comprehensive undersea situational awareness of large maritime expanses of strategic importance to inform undersea warfare responses.
Sponsor: Chief of Navy
DSTG Chief: Chief of Maritime Division
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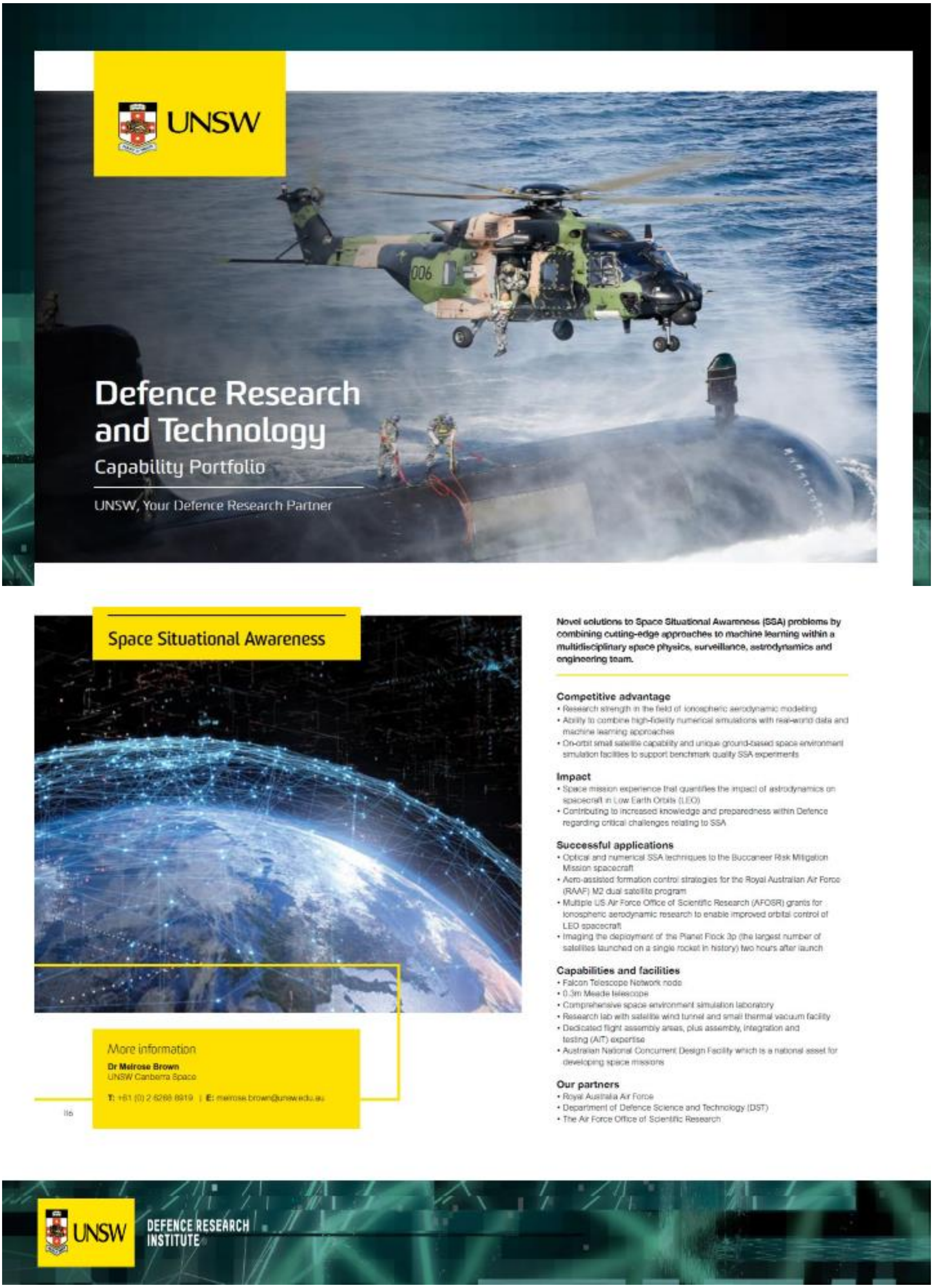
DEFENCE RESEARCH INSTITUTE


UNSW
Defence Research and Technology
Capability Portfolio
UNSW, Your Defence Research Partner
Space Situational Awareness
Novel solutions to Space Situational Awareness (SSA) problems by combining cutting-edge approaches to machine learning within a multidisciplinary space physics, surveillance, astrodynamics and engineering team.
Competitive advantage
• Research strength in the field of ionospheric aerodynamic modeling
• Ability to combine high-fidelity numerical simulations with real-world data and machine learning approaches
• On-orbit small satellite capability and unique ground-based space environment simulation facilities to support benchmark quality SSA experiments
Impact
• Space mission experience that quantifies the impact of astrodynamics on spacecraft in Low Earth Orbits (LEO)
• Contributing to increased knowledge and preparedness within Defence regarding critical challenges relating to SSA
Successful applications
• Optical and numerical SSA techniques to the Buccaneer Risk Mitigation Mission spacecraft
• Aero-assisted formation control strategies for the Royal Australian Air Force (RAAF) M2 dual satellite program
• Multiple US Air Force Office of Scientific Research (AFOSR) grants for ionospheric aerodynamic research to enable improved orbital control of LEO spacecraft
• Imaging the deployment of the Planet Flock 3p (the largest number of satellites launched on a single rocket in history) two hours after launch
Capabilities and facilities
• Falcon Telescope Network node
• 0.3m Meade telescope
• Comprehensive space environment simulation laboratory
• Research lab with satellite wind tunnel and small thermal vacuum facility
• Dedicated flight assembly areas, plus assembly, integration and testing (AIT) expertise
• Australian National Concurrent Design Facility which is a national asset for developing space missions
Our partners
• Royal Australia Air Force
• Department of Defence Science and Technology (DST)
• The Air Force Office of Scientific Research
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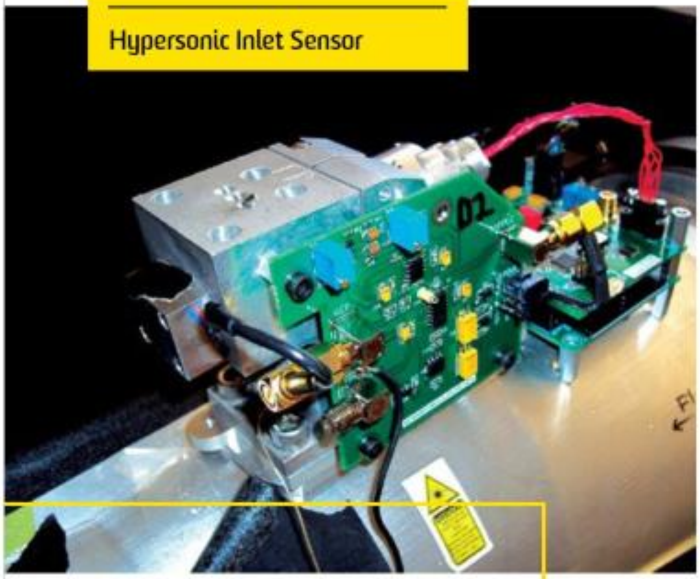
Hypersonic Inlet Sensor



High-speed Mach number and angle of attack sensor for hypersonic vehicles.

Competitive advantage

- Specifically designed for sensing applications in hypersonic flight
- The device is capable of measuring temperature, Mach number, speed and angle of attack for hypersonic vehicles
- Spin-off technology has been patented as an air-speed sensor for subsonic vehicles
- More stealthy and faster response rate than pitot tubes, and able to be used from subsonic to hypersonic flight domains
- Not as susceptible to icing as standard pitot tubes

Impact

- Enhanced control of hypersonic vehicles
- Replacement for pitot tubes in subsonic aircraft and large UAVs

Successful applications

Flight test associated with the Australian Space Research Program "Scramspace"

- Measured under 20 g acceleration conditions in flight
- Subject to obtaining an export licence, a proposed flight test with the Korean Aerospace Research Organisation KAIST
- Funding from the US Air Force

Capabilities and facilities

- In-house development of all optics, electronics and communications technologies

More information
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Trusted AI-Enabled Shepherding of Human-Swarm Teams

Technology to enable trusted inter-operation between humans and swarms of autonomous systems and platforms. Shepherding is the ability to guide, influence or reshape a group of autonomous systems towards a goal with optimised efforts to the shepherd and the group.

Competitive advantage

- A unique fully-distributed human-swarm and swarm-on-swarm systems exist that can scale arbitrarily to any size with minimum complexity. This technology achieves this in a structured, verifiable, trustworthy and scalable manner
- Multidisciplinary team with the capacity and facilities to prototype concepts theoretically, through simulation and on real-platforms
- Novel architectures to enable efficient, low-CPU, and highly smart AI-enabled swarm systems

Impact

- Enable commanders to take responsibility of large (semi-) autonomous heterogeneous swarms in a trusted, verifiable, and accountable manner
- CPU and power efficient, highly smart AI-enabled swarm systems
- Autonomous real-time management of the human-swarm relationship
- Scalability of human-swarm logic
- Transparent, explainable, and adaptive swarm control-logic
- Trusted human-swarm operations

Successful applications

- Autonomous coordination policies in ground-air unmanned systems interaction
- Autonomous learning, reasoning and decision-making in dynamic heterogeneous swarm environments
- Distributed contextual awareness for multi-agent systems and its application to military land vehicles

Capabilities and facilities

- Indoor Unmanned Aerial Vehicle (UAV) testing facilities
- High-fidelity simulation environments including air traffic management and modelling of uninhabited all-domains vehicles (UxVs)
- A variety of unmanned ground and air vehicles

Our partners

- Defence Science and Technology (DST)
- US Office of Naval Research
- US Air Force Office of Scientific Research
- US Army International Technology Center Pacific (ITC-PAC)

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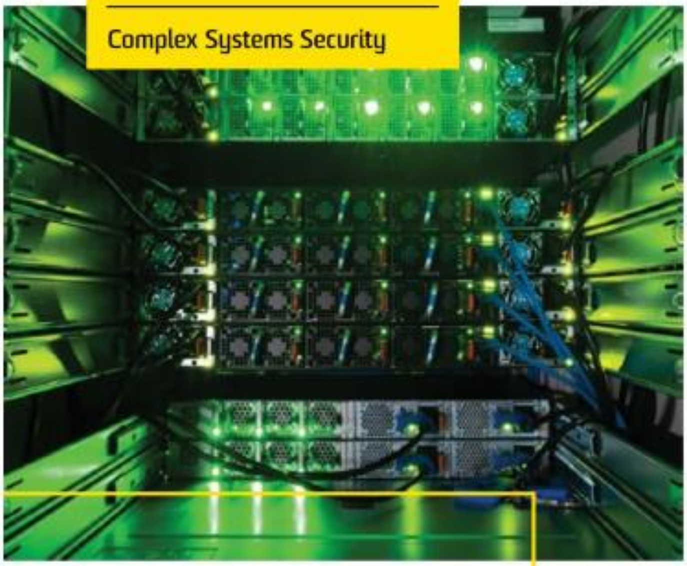
Complex Systems Security



More information

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UNSW Canberra Cyber

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Delivering a better understanding of the security of future networks and platforms; these networks include the Internet of Things, Industry 4.0, Industrial Control Systems that run Australia's critical infrastructure, and resilience of social networks against coercion and soft influence.

Competitive advantage

- Expertise in next-generation networks, critical infrastructure security, cyber-resilience and simulation
- World class experimentation development platforms and lab facilities
- Strong industry links to develop usable outcomes

Impact

- Development of new processes and techniques to discover vulnerabilities in large scale systems
- A holistic perspective on network development and security analysis
- Increasing resiliency of future networks against cyber threat
- Running wargames and scenario-based learning opportunities to understand future threats
- Cyber influence and security simulation platforms for decision support and situational awareness

Successful applications

- Social Media Dataset Generation, Australian Army
- An Intelligent Risk Evaluation Tool for Safeguarding IoT Smart Airports, Cyber Cooperative Research Centre (Cyber CRC)
- Cyber Supply Chain Mission Assurance, Australian Army
- Cyber Impact Analysis Towards Mission Assurance, Defence Science and Technology
- Secure Software Defined Networking for Multi-Bearer Time-Sensitive Distributed Systems, Defence Science and Technology

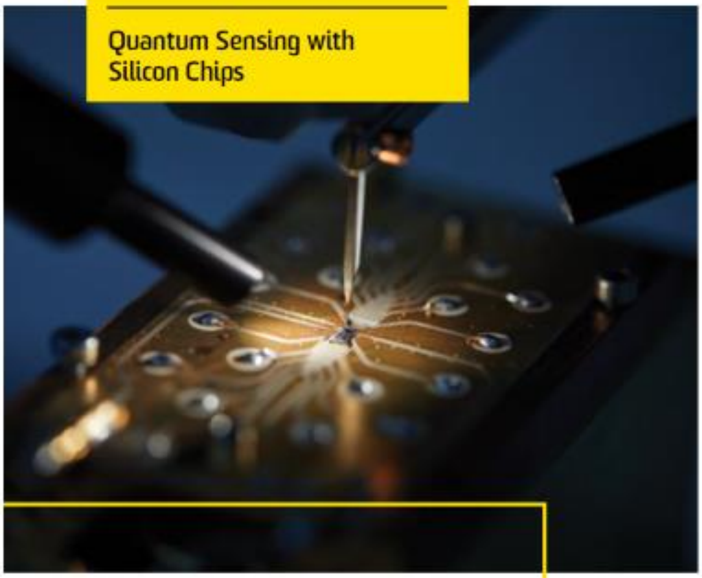
Capabilities and facilities

- UNSW Canberra Cyber Range
- Future-facing Internet-of-Things (IoT) Security Laboratory, incorporating realistic Supervisory Control and Data Acquisition (SCADA) and Industrial Control System (ICS) platforms

Our partners

- Information Warfare Division
- Defence Science and Technology Group
- The Netherlands Organisation (TNO)
- Domos

Quantum Sensing with Silicon Chips



More information

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Fundamental Quantum Technologies Laboratory

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Exploiting the inherent fragility of quantum systems to develop advanced sensors for weak electric and magnetic fields.

Competitive advantage

- First in the world to demonstrate a quantum bit in silicon, using the spin of a single atom, introduced in the chip via an industry-standard technology
- Record-holder for quantum memory time, which translates into a record sensitivity to perturbing electromagnetic fields
- International collaboration to develop novel methods for extracting the maximum information on the environment of the atom
- Extension of world-leading silicon-based quantum computer technology to demonstrate quantum sensors integrated within a silicon nanoelectronic device

Impact

- Substantial improvements in the sensitivity of sensors for defence systems
- Quantum sensors within silicon chips to facilitate integration with other functionalities

Capabilities and facilities

- Leading silicon nanofabrication facilities via the UNSW node of Australian National Fabrication Facility (ANFF) and unmatched in-house expertise
- Extensive platforms for quantum measurements in ultra-low temperature, high-frequency, low-noise environment
- International network of collaborators with access to state-of-the-art theoretical and computational facilities.

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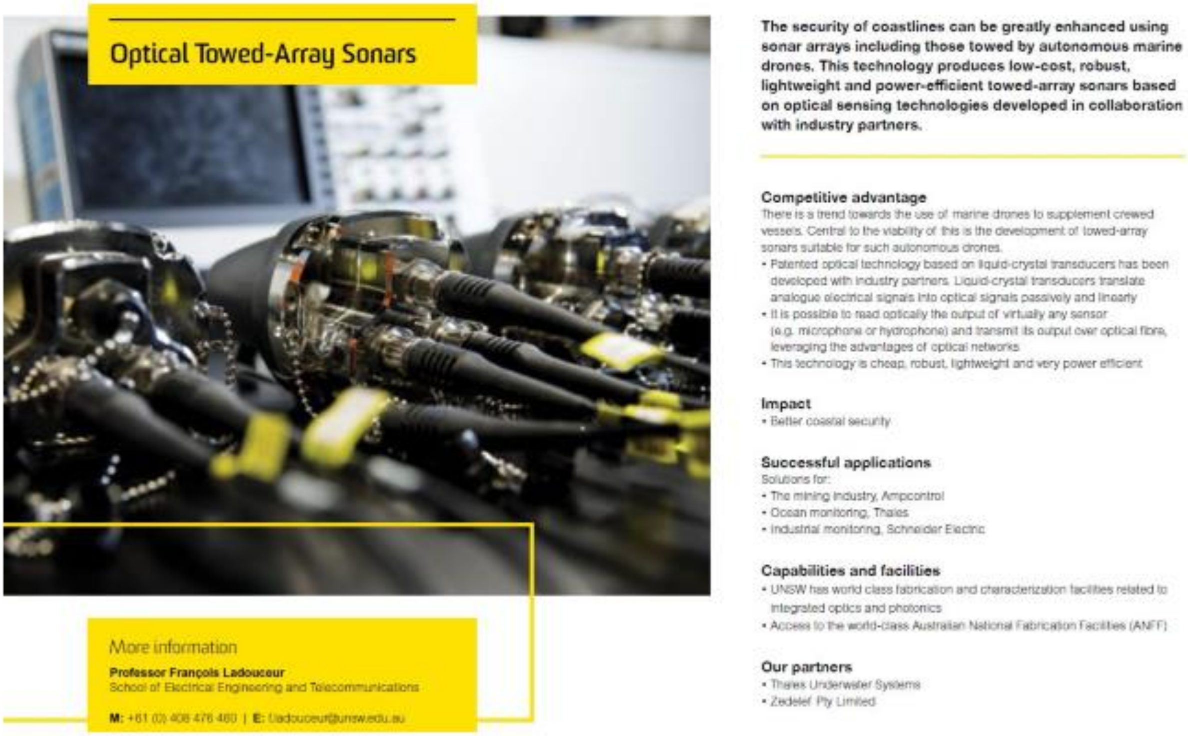

Defence research is an instrument of national power!

Q&A

Thank you!

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SPEAKER 3

Underwater Robot for Ocean Exploration & Surveillance

Prof. Bambang Riyanto Trilaksono
School of Electrical Engineering & Informatics, ITB
Center for Artificial Intelligence, ITB

Agenda

- Indonesian Ocean Potentials & Challenges
- Robotics Technology
- Underwater Robot & Design Issue
- Underwater Robot Types and Applications
- Underwater Robot Technology
- Recent Developments
- Closing Remarks

Indonesia as a Maritime Country

- Vast area of Indonesian ocean & wealth
- Indonesian ocean future challenges
- Underwater robot potentials
- Civil, research, military applications
- Research and innovation on underwater robot

Current ocean surveillance technology

COASTAL RADAR

- ➢ Restricted area
- ➢ Detection on ocean surface

Current ocean surveillance technology

BUOY FOR MARITIME SURVEILLANCE

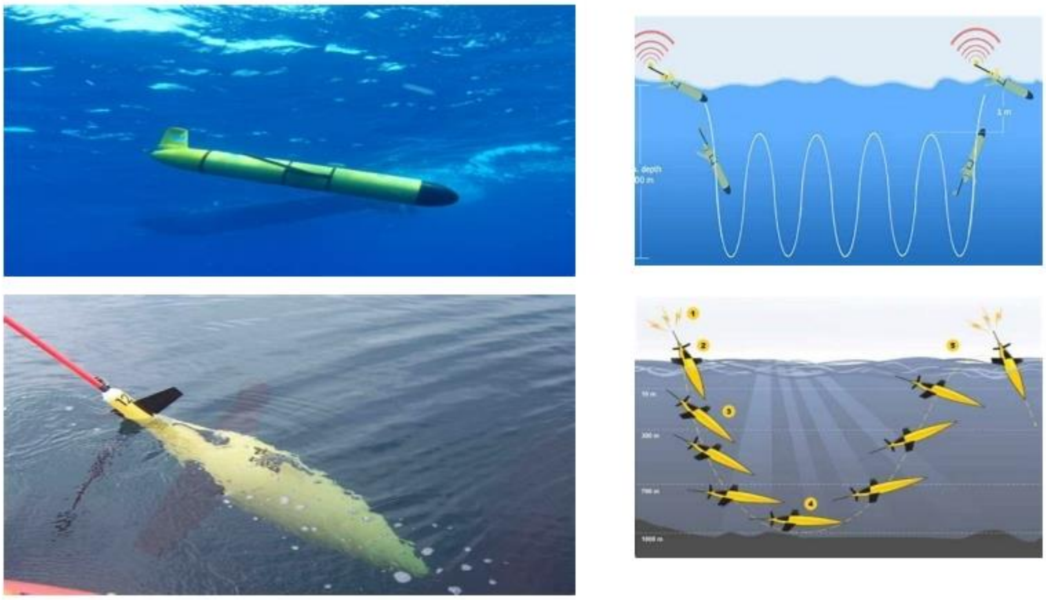
- ➢ Wider coverage are → a large number of units/systems
- ➢ Risk of vandalism

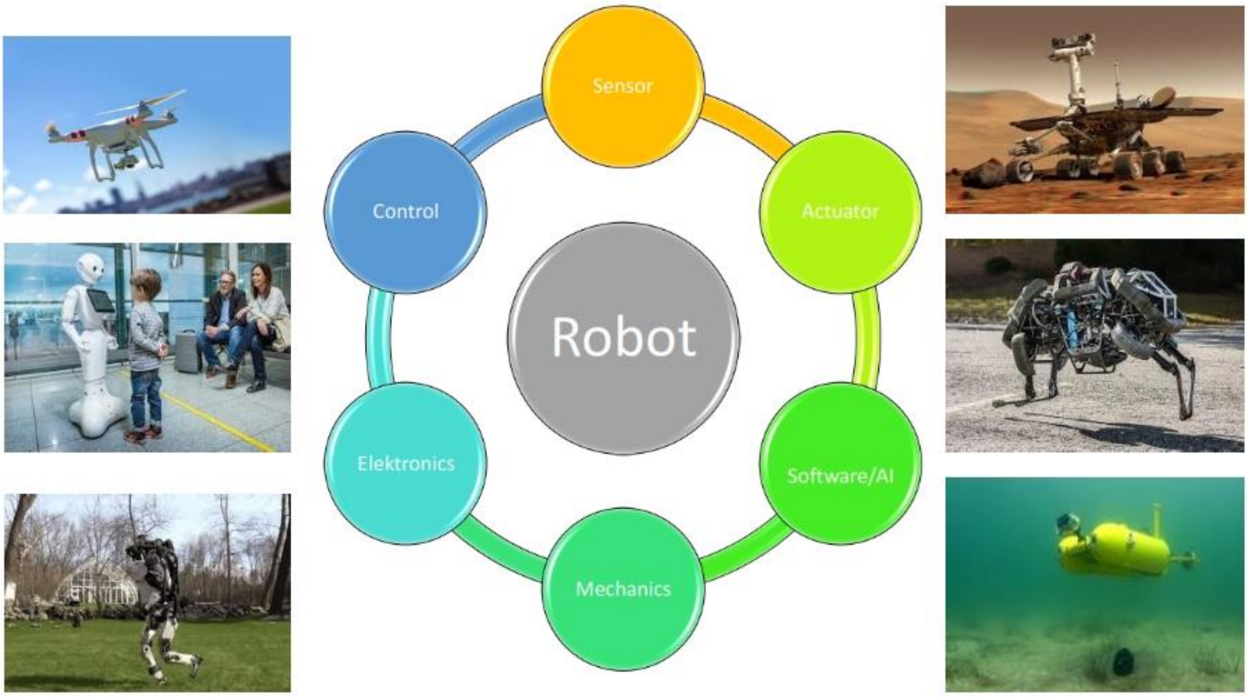
Backgound
Current ocean exploration technology

SURVEY/RESEARCH SHIPS (+ROV)

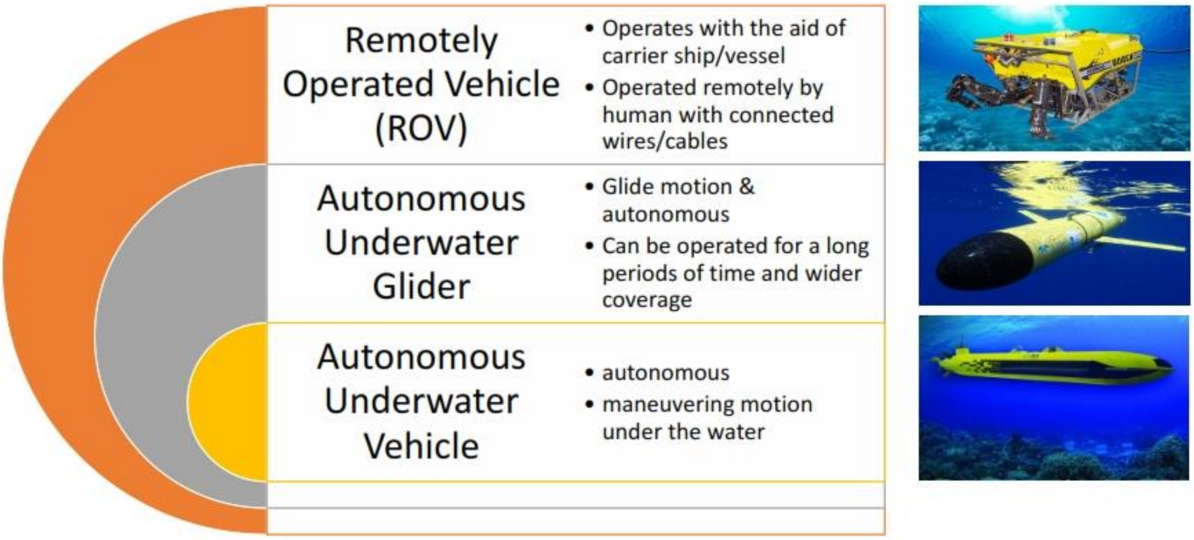
- ➢ High cost
- ➢ Safety of required divers
- ➢ ROV coverage depends on carrier ship/vessel
- ➢ High ROV power consumption

Proposed Solution : Underwater Glider

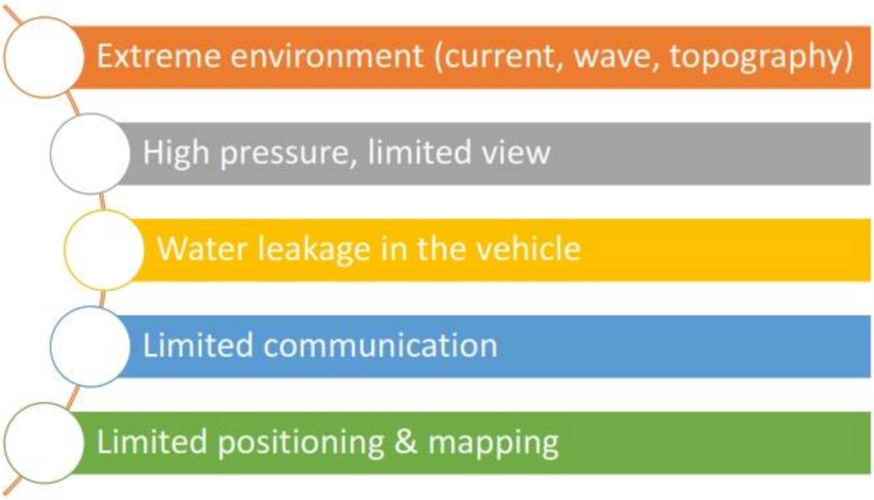




Underwater Robot Types



Design Issues of Underwater Robot



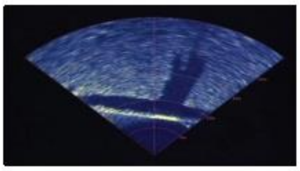

ROV
ROV KIEL 6000
SCORPIO


Autonomous Underwater Glider
GPS Receiver
Flip Rudder
RF Modem/Irridium Antenne
Propeller
Temperatur & Salinity Sensor
Bow Thruster
Hook
Fixed Rudder
Strobo/Emergency Lig
Fixed Wing
IMU Sys
Buoyance Engine
Doppler Velocity Log (DVL)
Bottom Detector (Altimeter)
Bow Thruster
Ascent and descent motion based on buoyancy principle
Gliding movement without thruster propeller
Long periods of operation time
Wide traveling coverage
Low energy consumption

Application Areas of Autonomous Underwater Glider

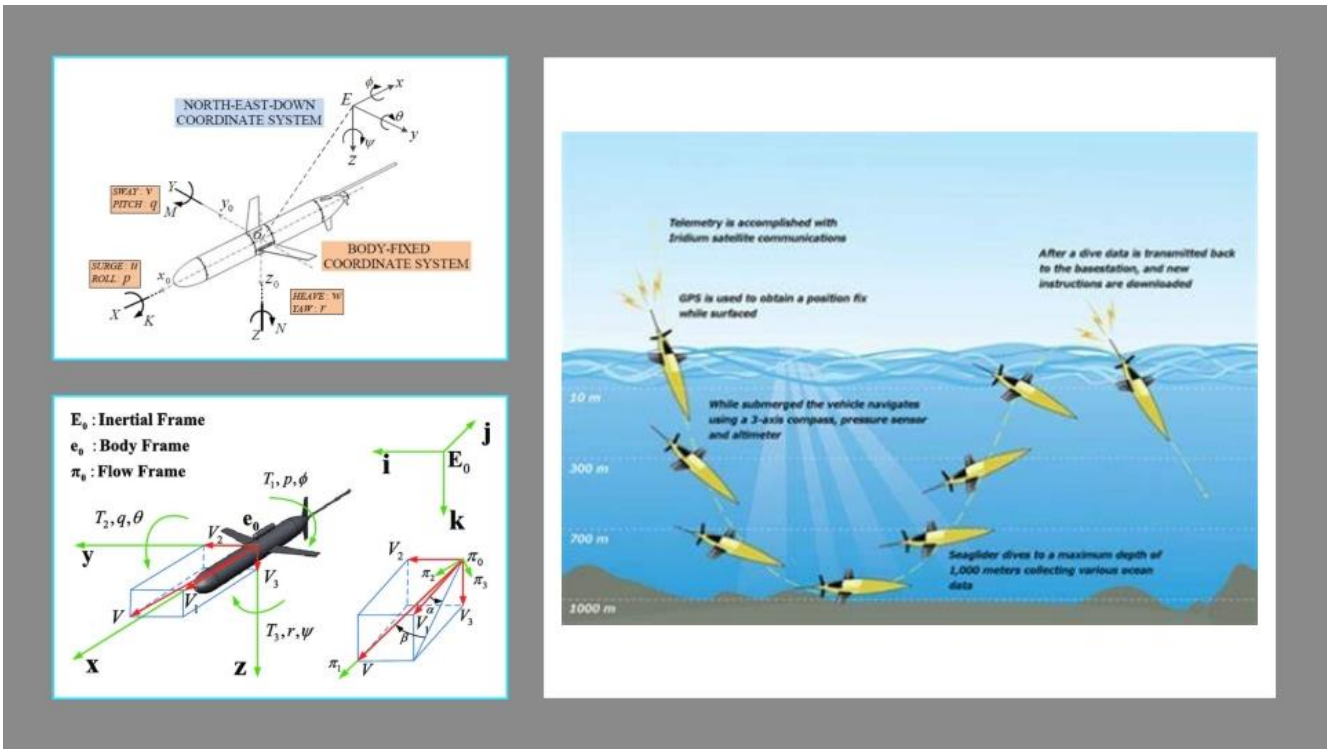
Various applications (depends on sensor payload + algorithm).

- Boundary surveillance (illegal fishing, illegal vessel, etc)
- Oil and gas exploration (deep sea)
- Bathymetry mapping (seafloor topography using sonar sensor)
- Ocean resource exploration(fish distribution mapping, ocean/region fertility)
- Oceanography (temperature, salinity profile)



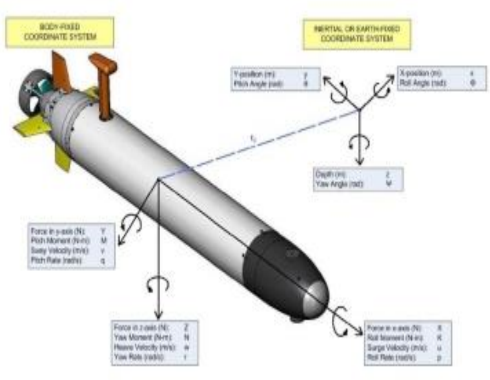
Autonomous Glider for Ocean Sampling

- Temperature
- Salinity
- Chlorophyll
- Sea current
- Sea depth



Underwater Vehicle Coordinate Systems

Vehicle Coordinate Systems



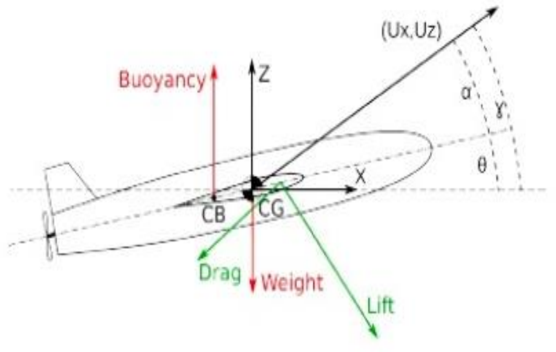
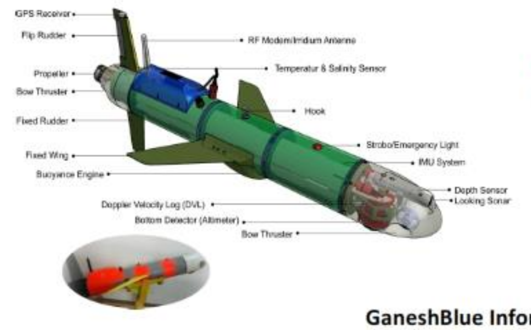


Fig. 1. Schematic representation of the principle of operation of an underwater glider. θ, α, and γ are the pitch, angle of attack, and glide path angles, respectively (forces and moments exaggerated for clearer presentation).



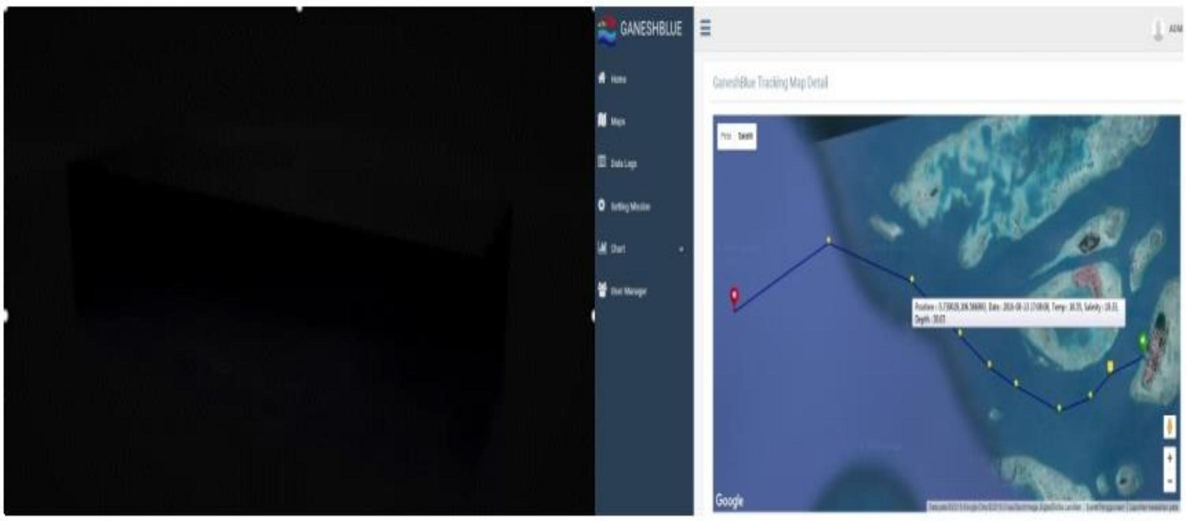
A prototype of underwater glider operated through ground control station using radio and/or satellite communication

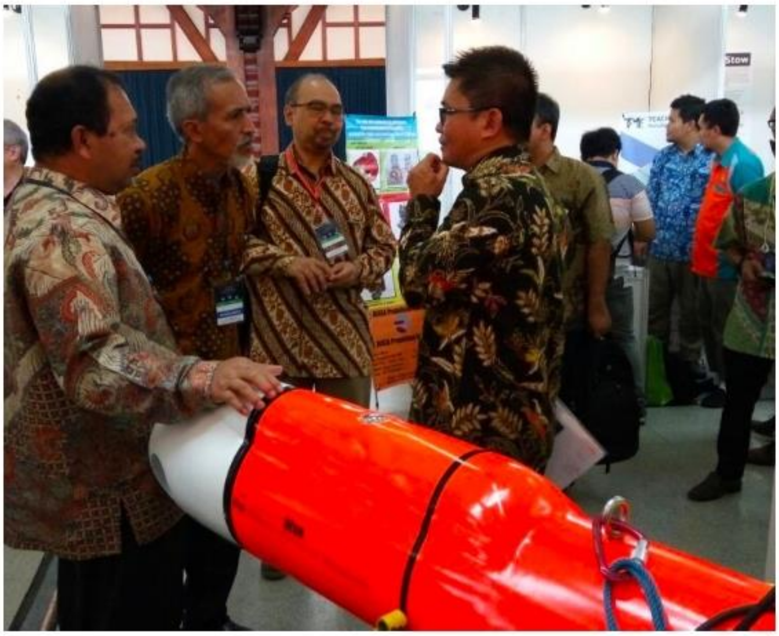
Tabel 1. Spesifikasi GaneshBlue Underwater Glider (2017)

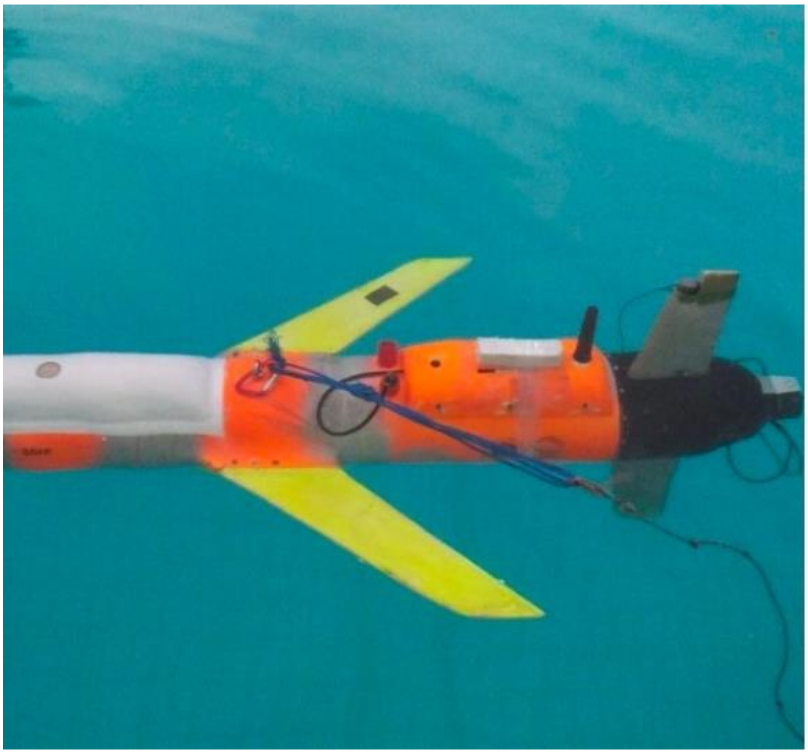
Panjang	2105 mm
Diameter	250 mm
Lebar (wings span)	890 mm
Tinggi (rudder span)	900 mm
Massa di udara	94.4 kg
Kedalaman operasi maksimum	200 m
Long-endurance	1 bulan (tergantung mode operasi)
Kecepatan maksimum	0.2 – 0.3 m/sec
Sudut glide	5 - 45°
Baterai	Lithium Ferro Phosphate 12V/100Ah
Sensor untuk kendali attitude wahana	IMU 9 Degree-of-freedom
Navigasi	GPS (latitude-longitude), tingkat akurasi 2m Micro DVL 600
Komunikasi	Radio RF Modem XTEND 64nm Opsional : Iridium Sattelite Com.
Obstacle avoidance	Looking sonar Altisounder Acoustic Doppler (DVL)
Gerak transversal Gerak rotasi	Propeller-blade pada bagian belakang Bow tthuster (depan dan belakang)
Data pengukuran	Temperatur dan salinitas (CTD meter)

GaneshBlue Underwater Glider

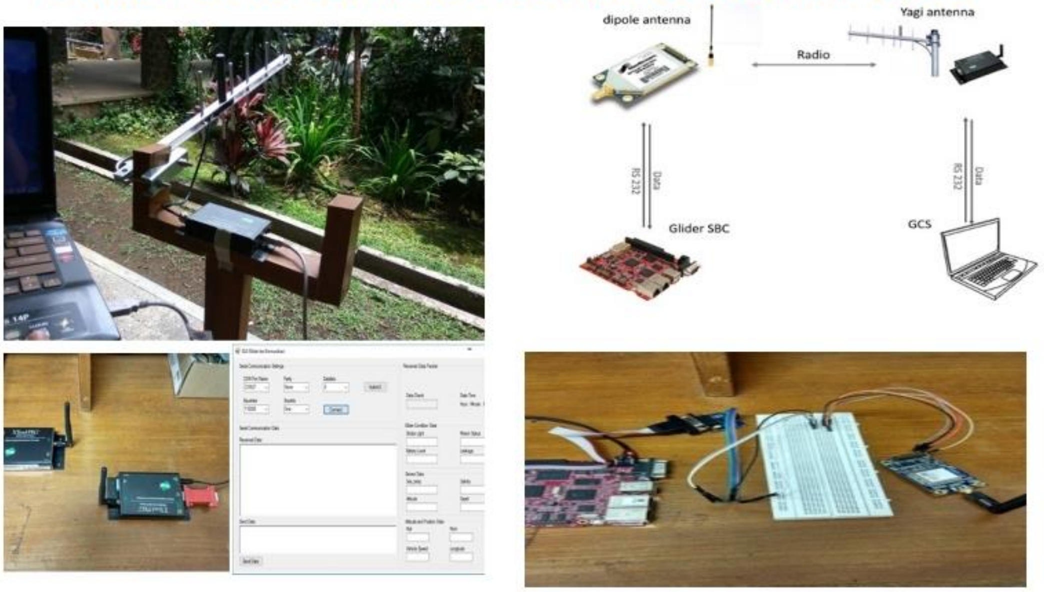
Underwater Glider





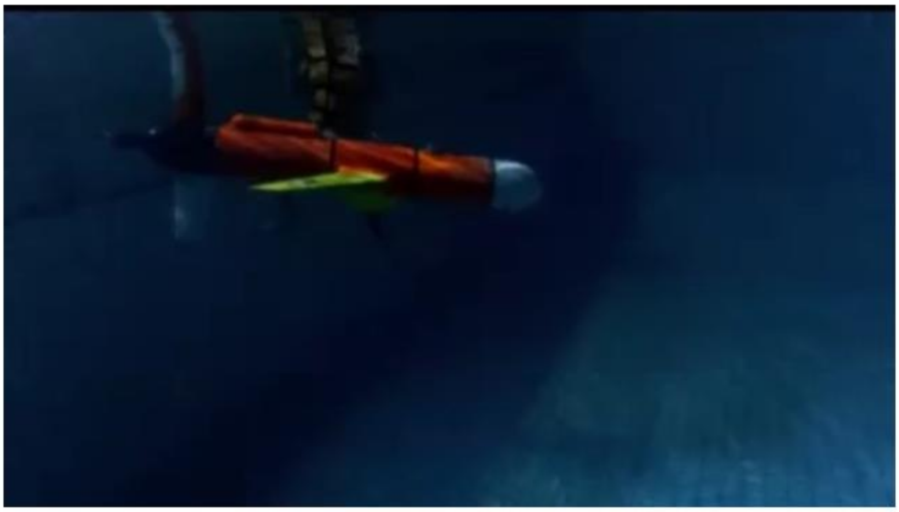


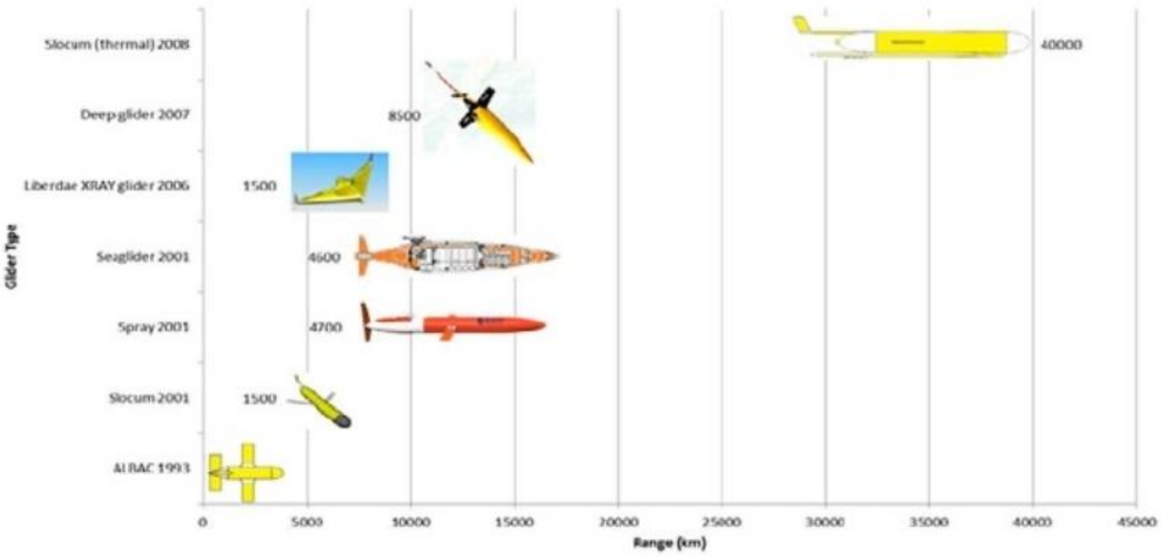
Glider data communication & instruments

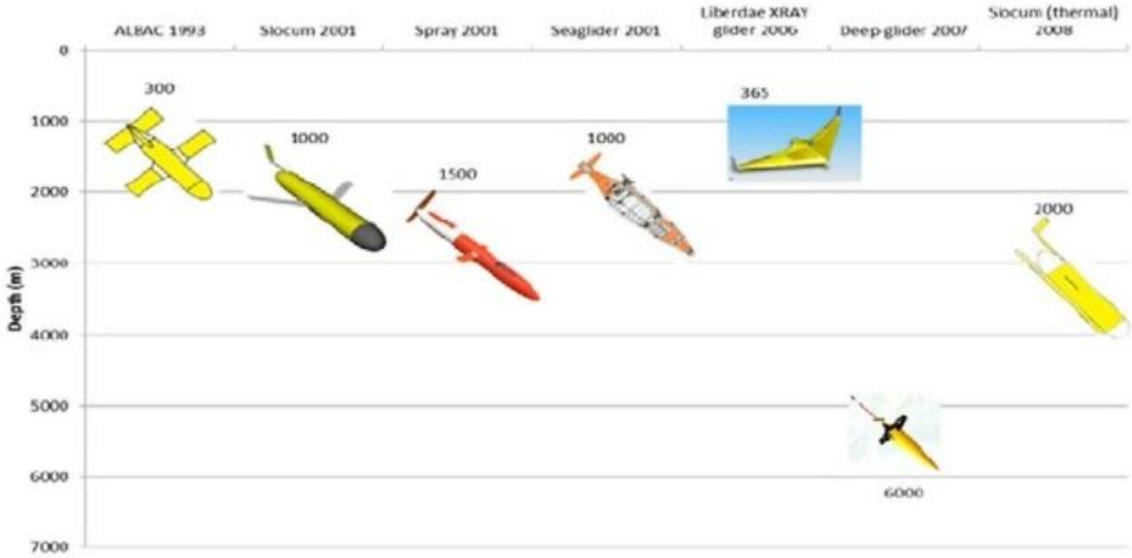


Lab Scale Testing

Basic Gliding Test







AUV (Autonomous Underwater Vehicle)

- Driven by a propulsion system
- Controlled and piloted by an onboard computer
- Maneuverable in three dimensions
- Support spatial and time series measurements
- Normally provide superior quality data
- Support multiple vehicle operations
- Can insure adequate spatial and temporal sampling

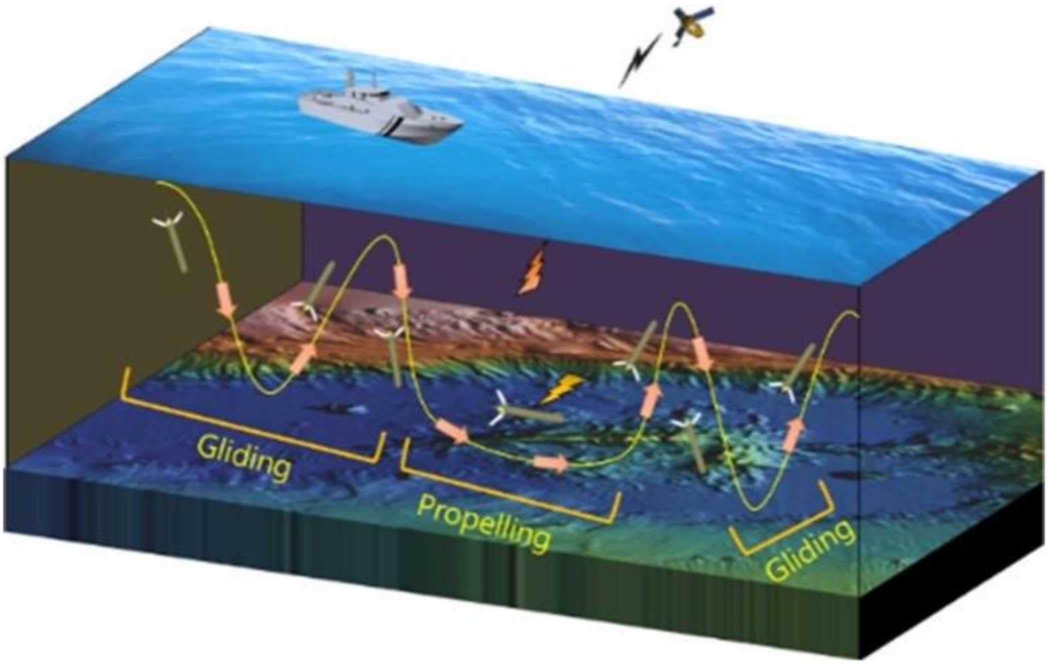
AUV (Autonomous Underwater Vehicle) Applications

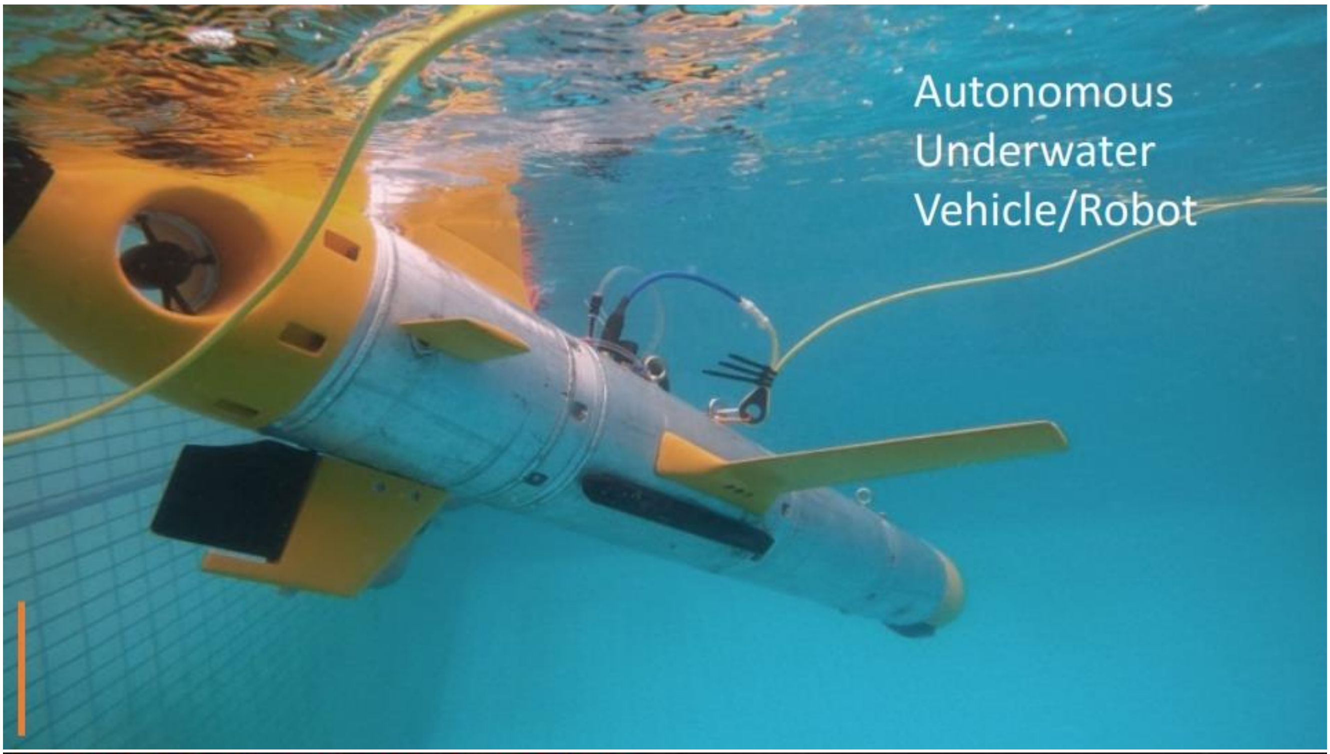
Commercial & Research

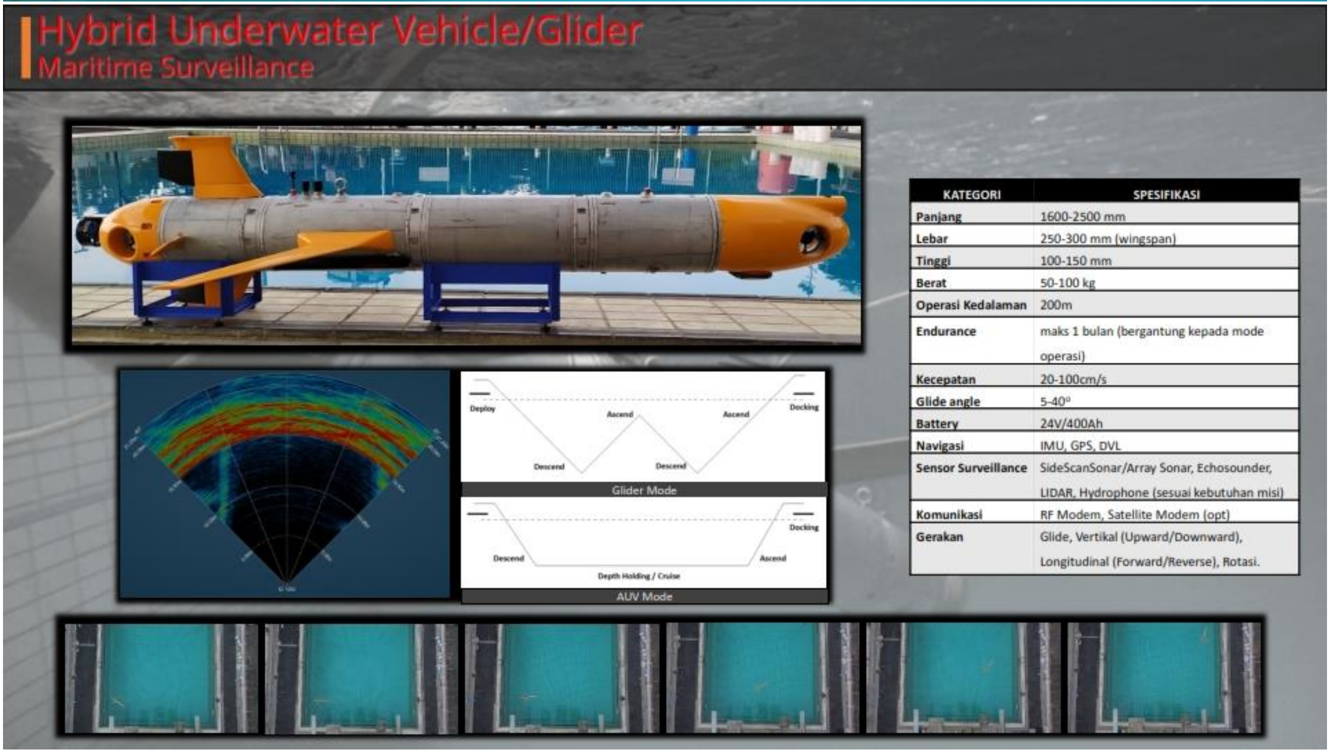
- Bathymetry
- Ocean sampling
- Ocean resources exploration
- Oil and gas resource exploration
- Climate prediction

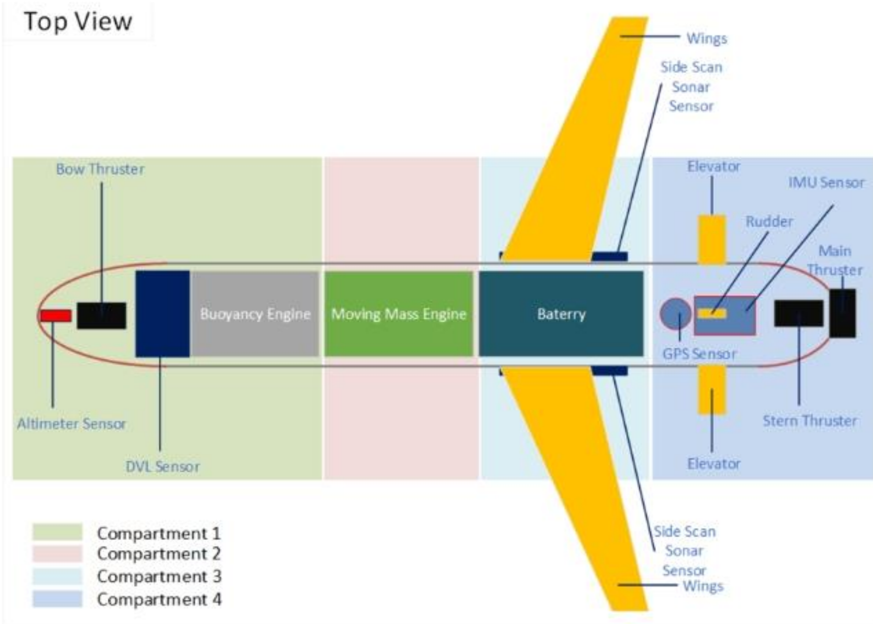
Military

- Intelligence, surveillance, and reconnaissance
- Mine countermeasures
- Anti-submarine warfare
- Inspection/identification
- Oceanography
- Communication/navigation network nodes
- Payload delivery
- Information operations
- Time-critical strikes




Autonomous
Underwater
Vehicle/Robot

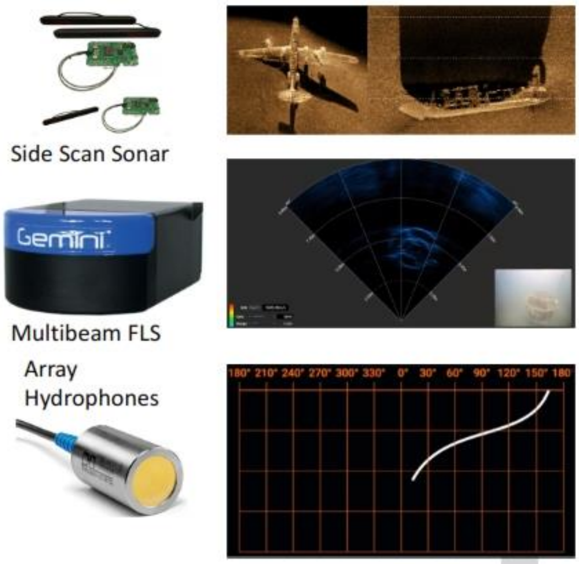

Hybrid Underwater Vehicle/Glider
Maritime Surveillance
KATEGORI | SPESIFIKASI
Panjang | 1600-2500 mm
Lebar | 250-300 mm (wingspan)
Tinggi | 100-150 mm
Berat | 50-100 kg
Operasi Kedalaman | 200m
Endurance | maks 1 bulan (bergantung kepada mode operasi)
Kecepatan | 20-100cm/s
Glide angle | 5-40°
Battery | 24V/400Ah
Navigasi | IMU, GPS, DVL
Sensor Surveillance | SideScanSonar/Array Sonar, Echosounder, LIDAR, Hydrophone (sesuai kebutuhan misi)
Komunikasi | RF Modem, Satellite Modem (opt)
Gerakan | Glide, Vertikal (Upward/Downward), Longitudinal (Forward/Reverse), Rotasi.
Deploy
Ascend
Ascend
Docking
Descend
Descend
Glider Mode
Docking
Descend
Ascend
Depth Holding / Cruise
AUV Mode


Top View
Wings
Side Scan
Sonar
Sensor
Bow Thruster
Elevator
IMU Sensor
Rudder
Main
Thruster
Buoyancy Engine
Moving Mass Engine
Baterry
GPS Sensor
Altimeter Sensor
DVL Sensor
Stern Thruster
Elevator
Side Scan
Sonar
Sensor
Wings
Compartment 1
Compartment 2
Compartment 3
Compartment 4

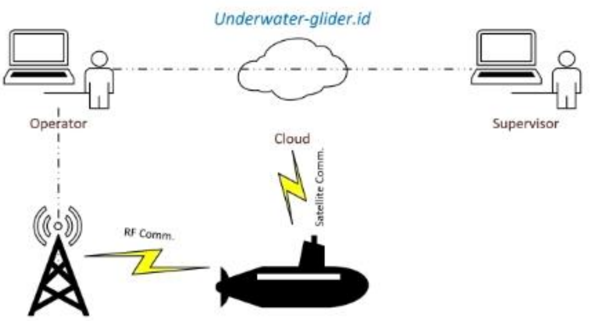

ITB Hybrid Glider

ITB Hybrid Glider for Surveillance

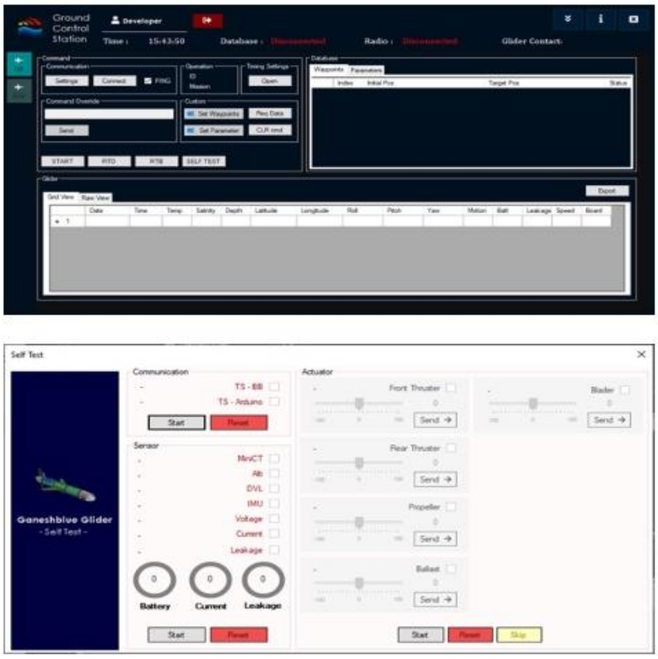
Payload needed for surveillance



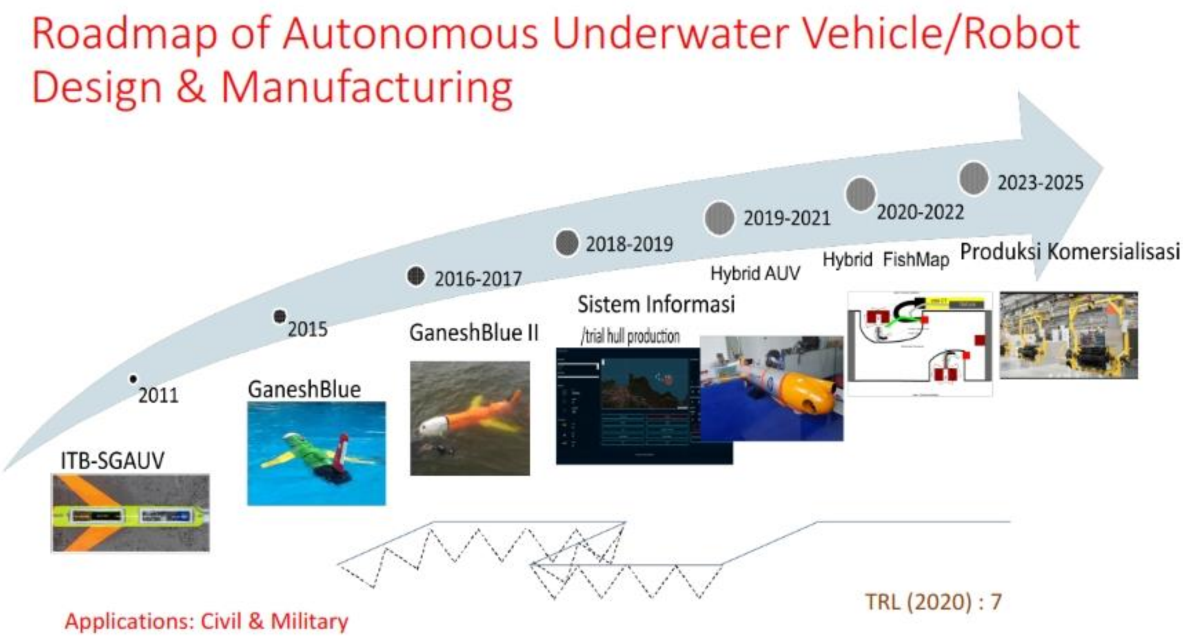
Web based GCS & Data Communication

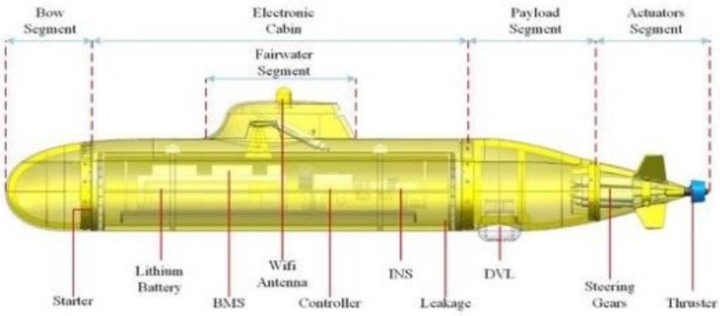


GCS

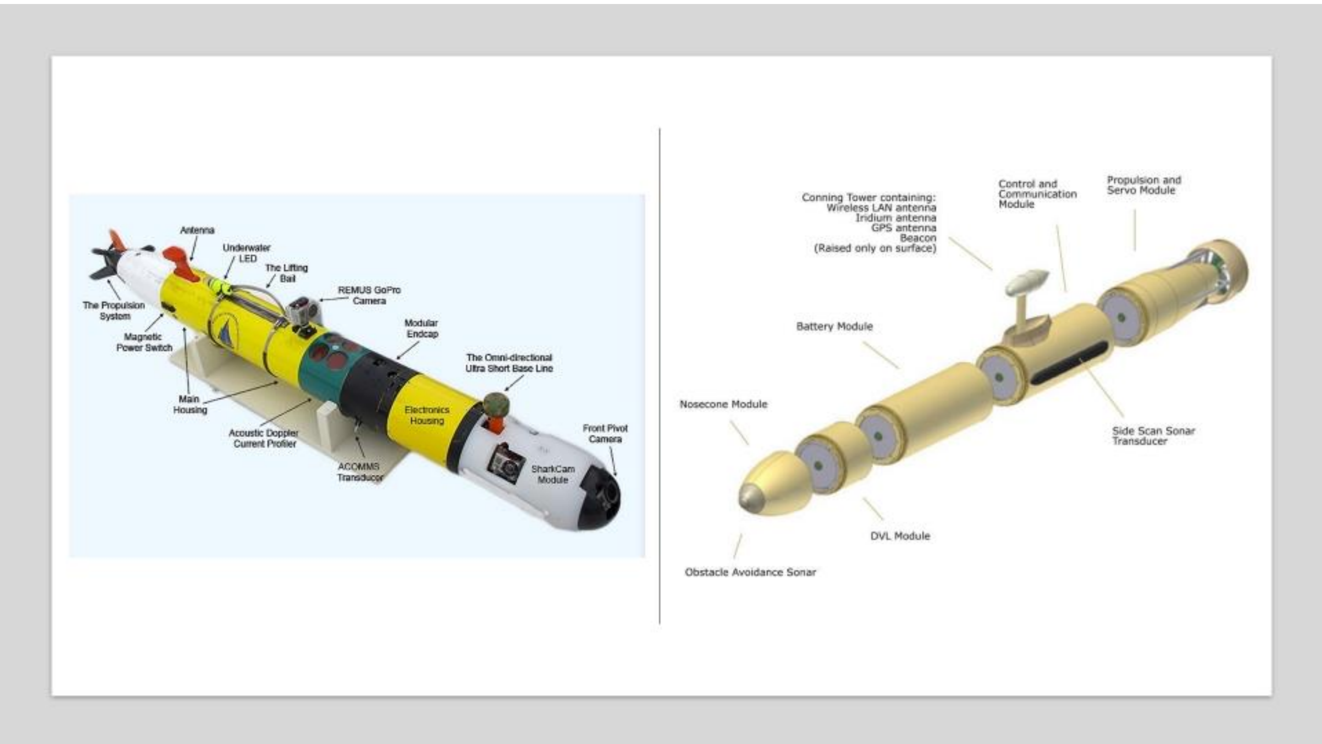


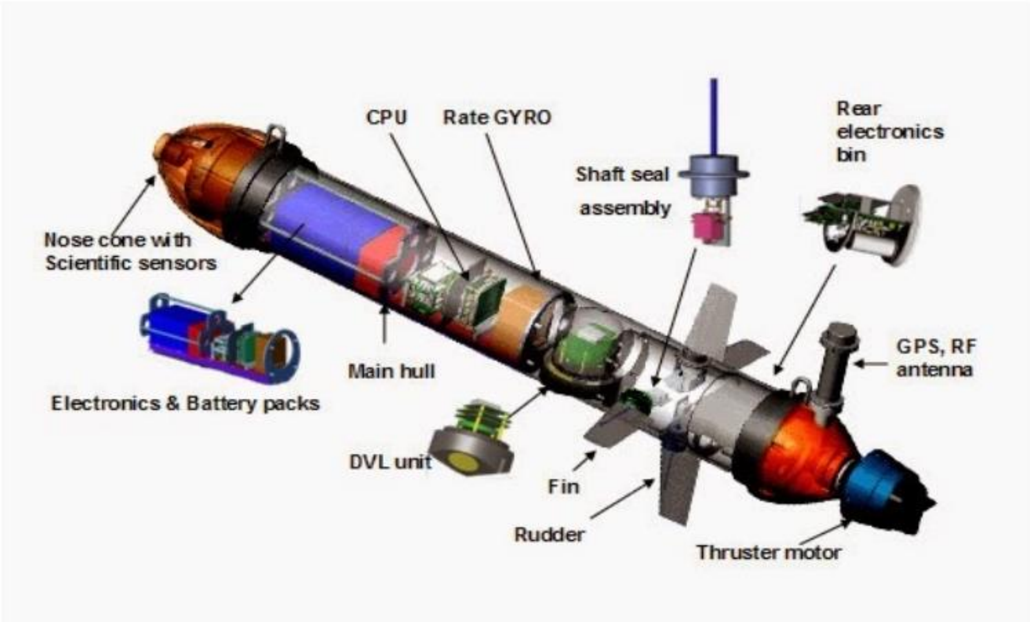
Web Display

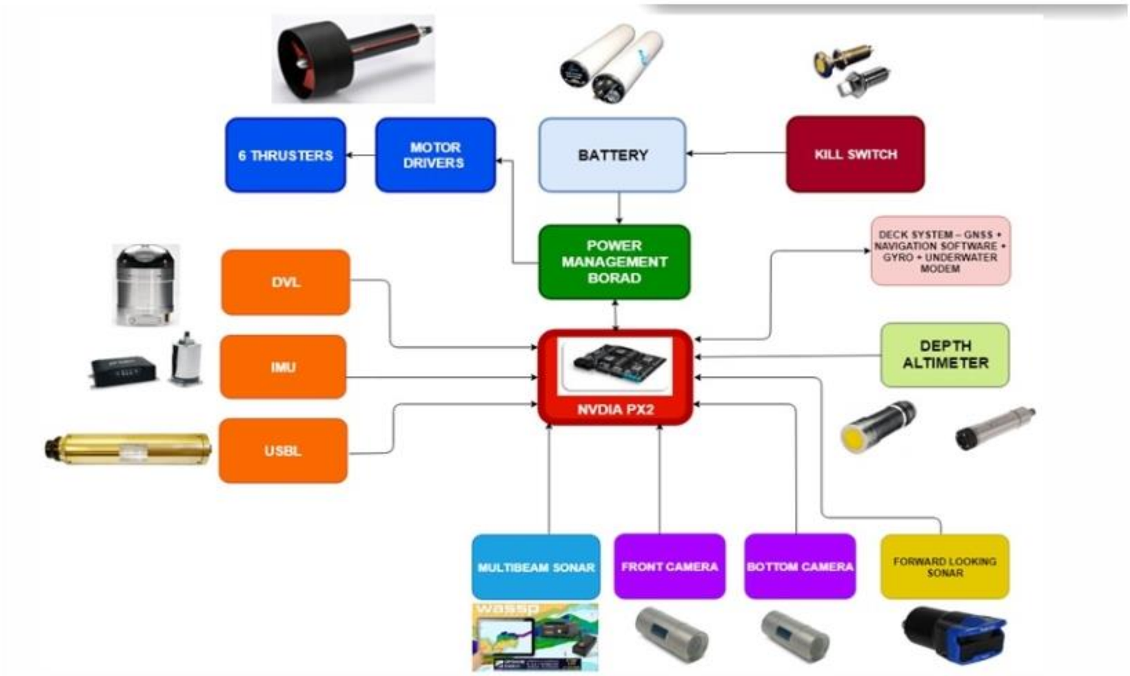



Bow Segment
Electronic Cabin
Payload Segment
Actuators Segment
Fairwater Segment
Starter
Lithium Battery
BMS
Wifi Antenna
Controller
INS
Leakage
DVL
Steering Gears
Thruster


Emergency light
Communications
Lift bail
Motor assembly
System electronics
Auxilliary battery tray
CTD
HYDROID
REMUS
Paroscientific pressure/depth sensor
Acoustic communications
LBL emergency
Main battery pack
Inertial navigation system
Coupled withDVL
Side scan sonar
Pensil beam
Ruggedized laptop computer

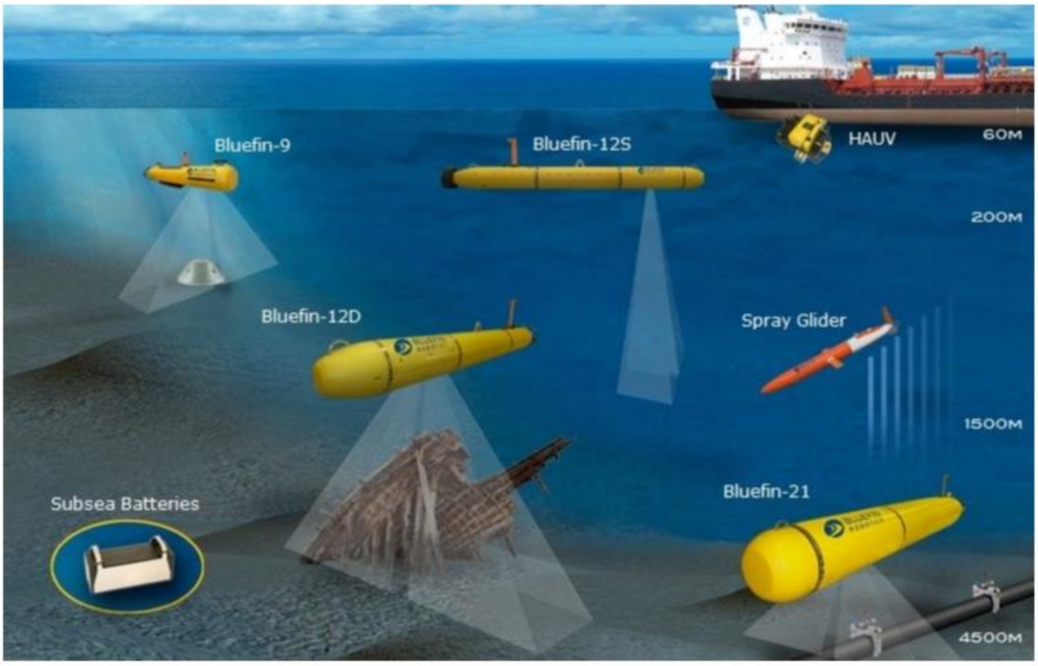

Antenna
Underwater LED
The Lifting Bail
REMUS GoPro Camera
The Propulsion System
Magnetic Power Switch
Modular Endcap
The Omni-directional Ultra Short Base Line
Main Housing
Electronics Housing
Front Pivot Camera
Acoustic Doppler Current Profiler
ACOMMS Transducer
SharkCam Module
Conning Tower containing:
Wireless LAN antenna
Iridium antenna
GPS antenna
Beacon
(Raised only on surface)
Control and Communication Module
Propulsion and Servo Module
Battery Module
Nosecone Module
Side Scan Sonar Transducer
DVL Module
Obstacle Avoidance Sonar

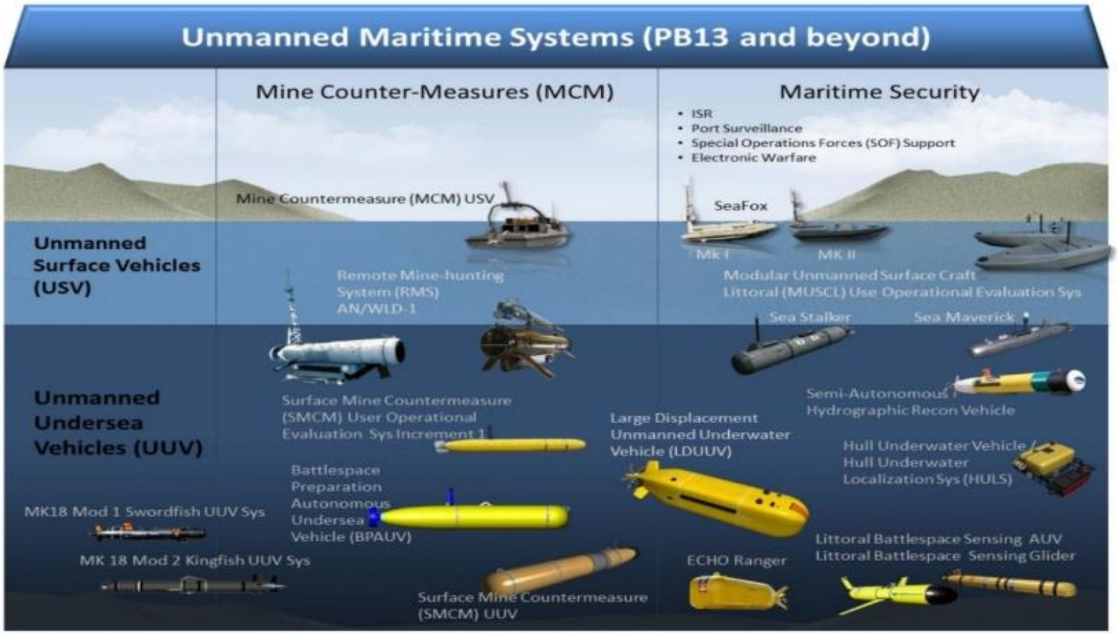

CPU
Rate GYRO
Rear electronics bin
Shaft seal assembly
Nose cone with Scientific sensors
GPS, RF antenna
Main hull
Electronics & Battery packs
DVL unit
Fin
Rudder
Thruster motor


6 THRUSTERS
MOTOR DRIVERS
BATTERY
KILL SWITCH
POWER MANAGEMENT BORAD
DECK SYSTEM – GNSS • NAVIGATION SOFTWARE • GYRO • UNDERWATER MODEM
DVL
IMU
USBL
NVDIA PX2
DEPTH ALTIMETER
MULTIBEAM SONAR
FRONT CAMERA
BOTTOM CAMERA
FORWARD LOOKING SONAR

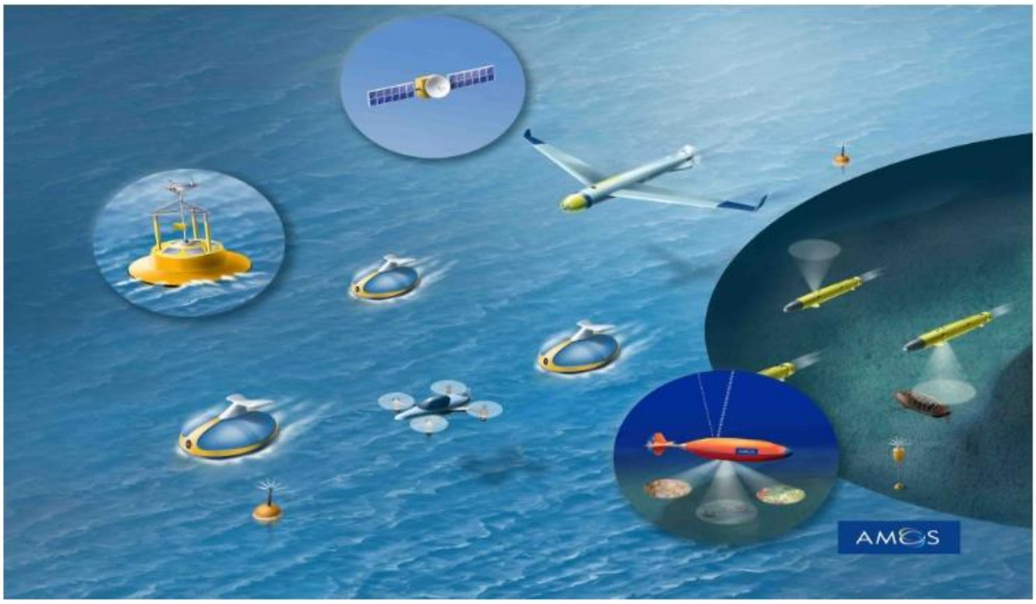
Software for Underwater Robot

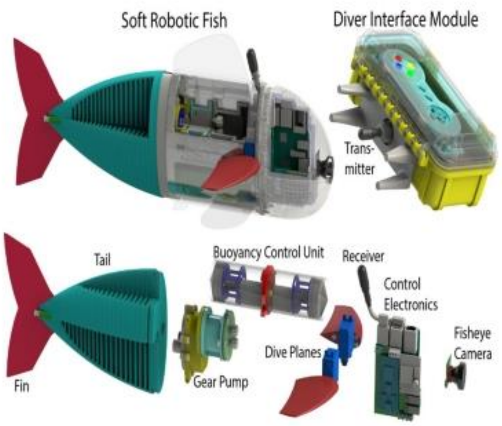
- ROS (Robotics Operating Systems)
- MOOS (Mission Oriented Operating Suite)
- Custom Software

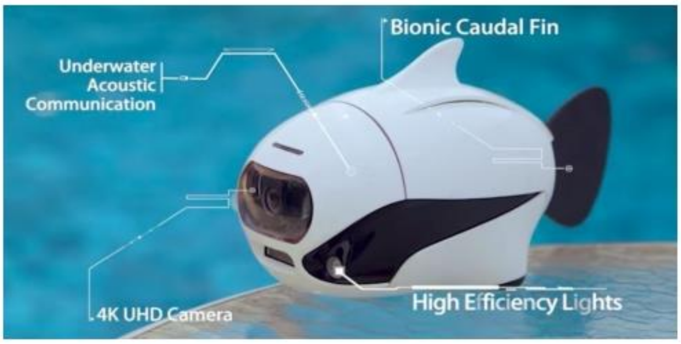

Bluefin-9
Bluefin-12S
HAUV
60M
200M
Bluefin-12D
Spray Glider
1500M
Subsea Batteries
Bluefin-21
4500M

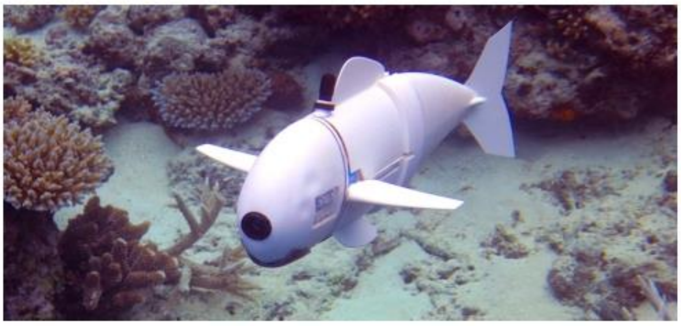

Unmanned Maritime Systems (PB13 and beyond)
Mine Counter-Measures (MCM)
Maritime Security
• ISR
• Port Surveillance
• Special Operations Forces (SOF) Support
• Electronic Warfare
Mine Countermeasure (MCM) USV
SeaFox
Mk I
MK II
Unmanned Surface Vehicles (USV)
Remote Mine-hunting System (RMS) AN/WLD-1
Modular Unmanned Surface Craft Littoral (MUSCL) Use Operational Evaluation Sys
Sea Stalker
Sea Maverick
Unmanned Undersea Vehicles (UUV)
Surface Mine Countermeasure (SMCM) User Operational Evaluation Sys Increment 1
Semi-Autonomous Hydrographic Recon Vehicle
Large Displacement Unmanned Underwater Vehicle (LDUUV)
Hull Underwater Vehicle / Hull Underwater Localization Sys (HULS)
Battlespace Preparation Autonomous Undersea Vehicle (BPAUV)
MK18 Mod 1 Swordfish UUV Sys
MK 18 Mod 2 Kingfish UUV Sys
Littoral Battlespace Sensing AUV
Littoral Battlespace Sensing Glider
ECHO Ranger
Surface Mine Countermeasure (SMCM) UUV

Collaborative Autonomous Unmanned Vehicle Systems





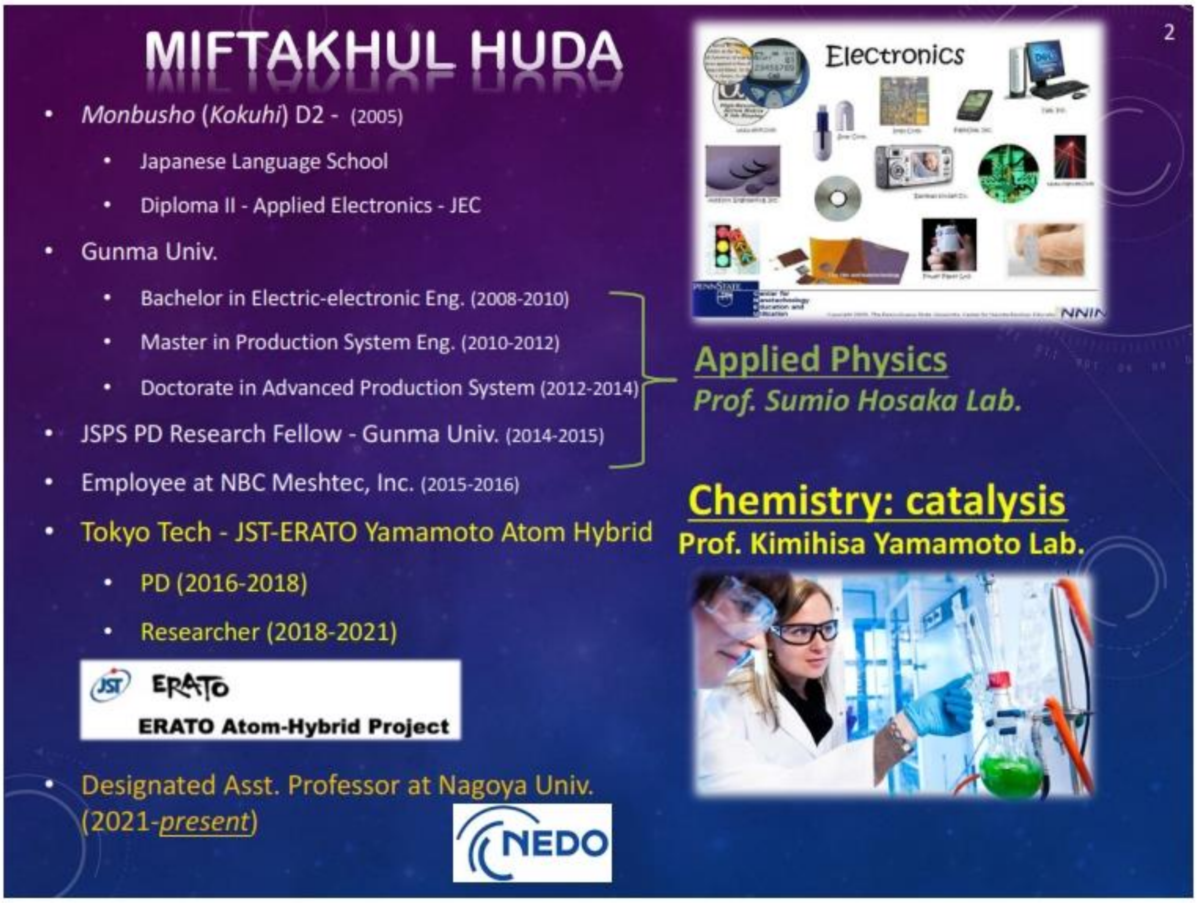




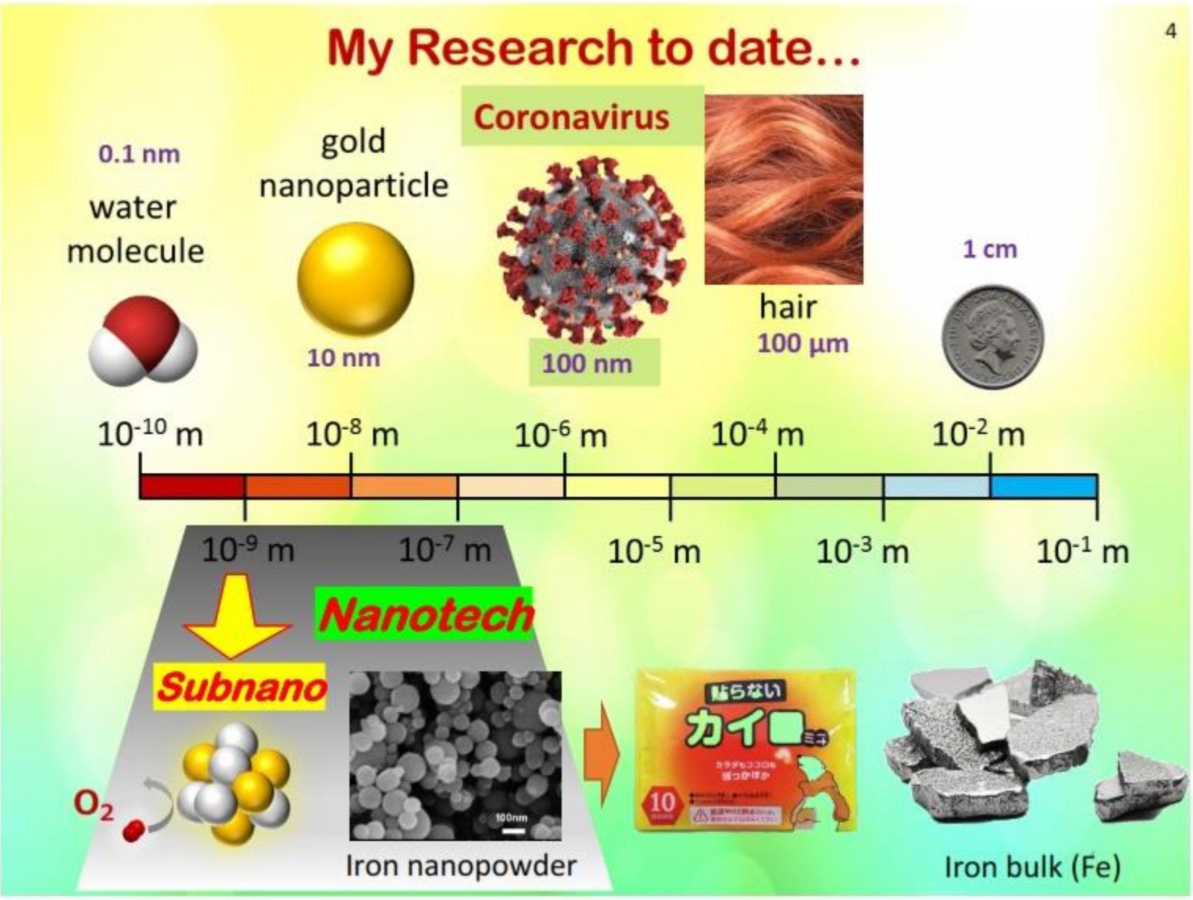
THANK YOU

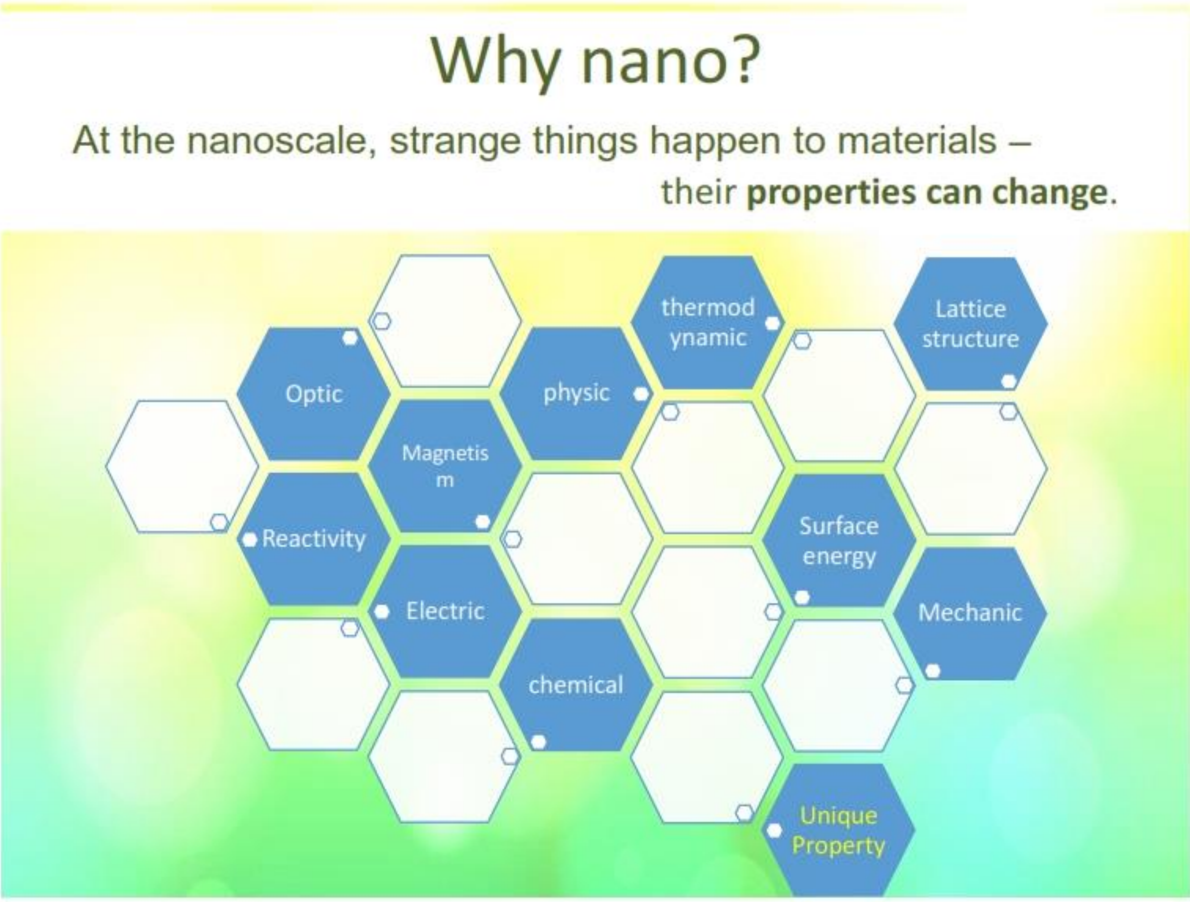
SPEAKER 4


ICMST 2021
May 27th, 2021
- From Nano To Subnano -
SELF-ASSEMBLED
NANODOT & CATALYST
MIFTAKHUL HUDA
Designated Assistant Professor
Nagoya University, Japan


MIFTAKHUL HUDA
2
Monbusho (Kokuhi) D2 - (2005)
Japanese Language School
Diploma II - Applied Electronics - JEC
Gunma Univ.
Bachelor in Electric-electronic Eng. (2008-2010)
Master in Production System Eng. (2010-2012)
Doctorate in Advanced Production System (2012-2014)
JSPS PD Research Fellow - Gunma Univ. (2014-2015)
Employee at NBC Meshtec, Inc. (2015-2016)
Tokyo Tech - JST-ERATO Yamamoto Atom Hybrid
PD (2016-2018)
Researcher (2018-2021)
ERATO
ERATO Atom-Hybrid Project
Designated Asst. Professor at Nagoya Univ. (2021-present)
NEDO
Electronics
Applied Physics
Prof. Sumio Hosaka Lab.
Chemistry: catalysis
Prof. Kimihisa Yamamoto Lab.


3
The Contents
• Introduction of Nanotechnology
• Research of Nanodots
• Research of Subnanocatalysts
• My Present Research

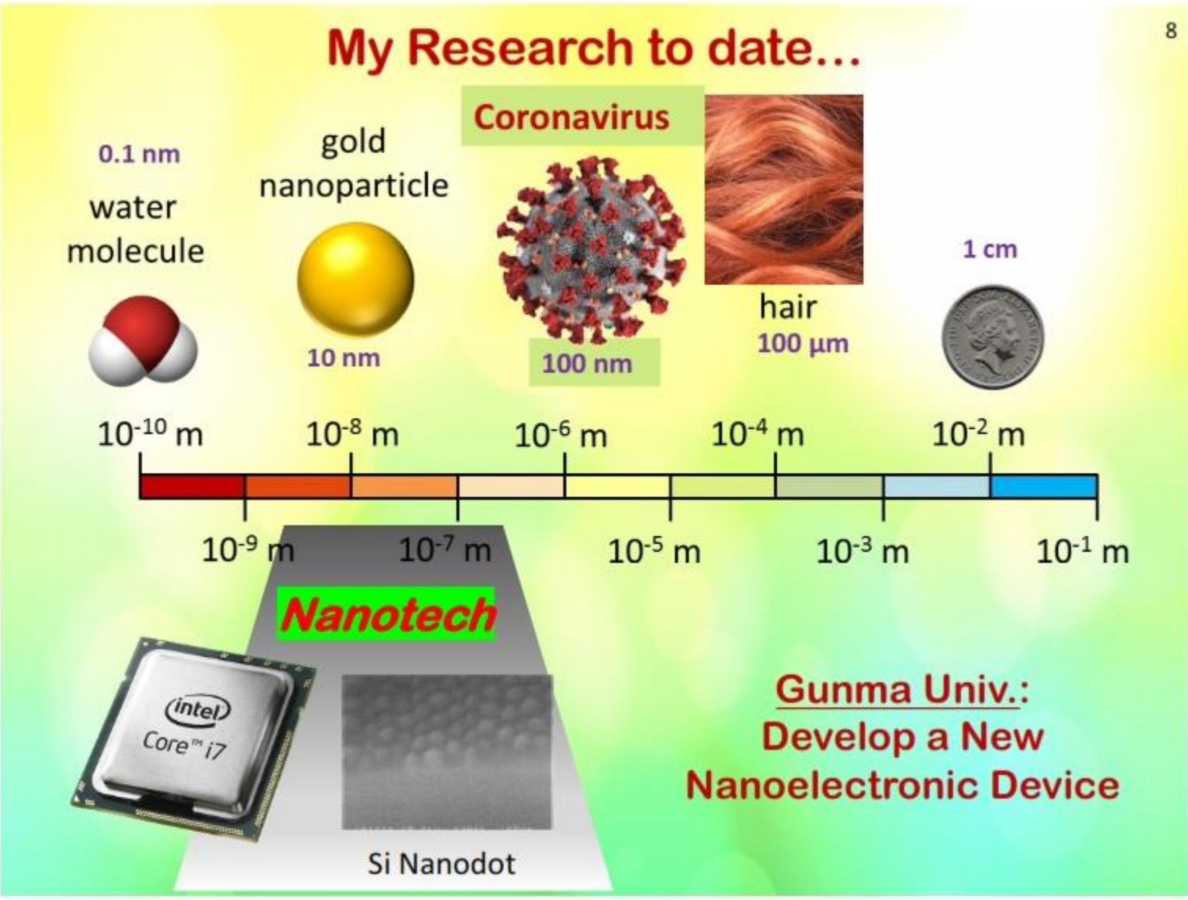

4
My Research to date…
0.1 nm
water molecule
gold nanoparticle
10 nm
Coronavirus
100 nm
hair
100 µm
1 cm
10^{-10} m
10^{-8} m
10^{-6} m
10^{-4} m
10^{-2} m
10^{-9} m
10^{-7} m
10^{-5} m
10^{-3} m
10^{-1} m
Nanotech
Subnano
O_2
100nm
Iron nanopowder
貼らない
Iron bulk (Fe)

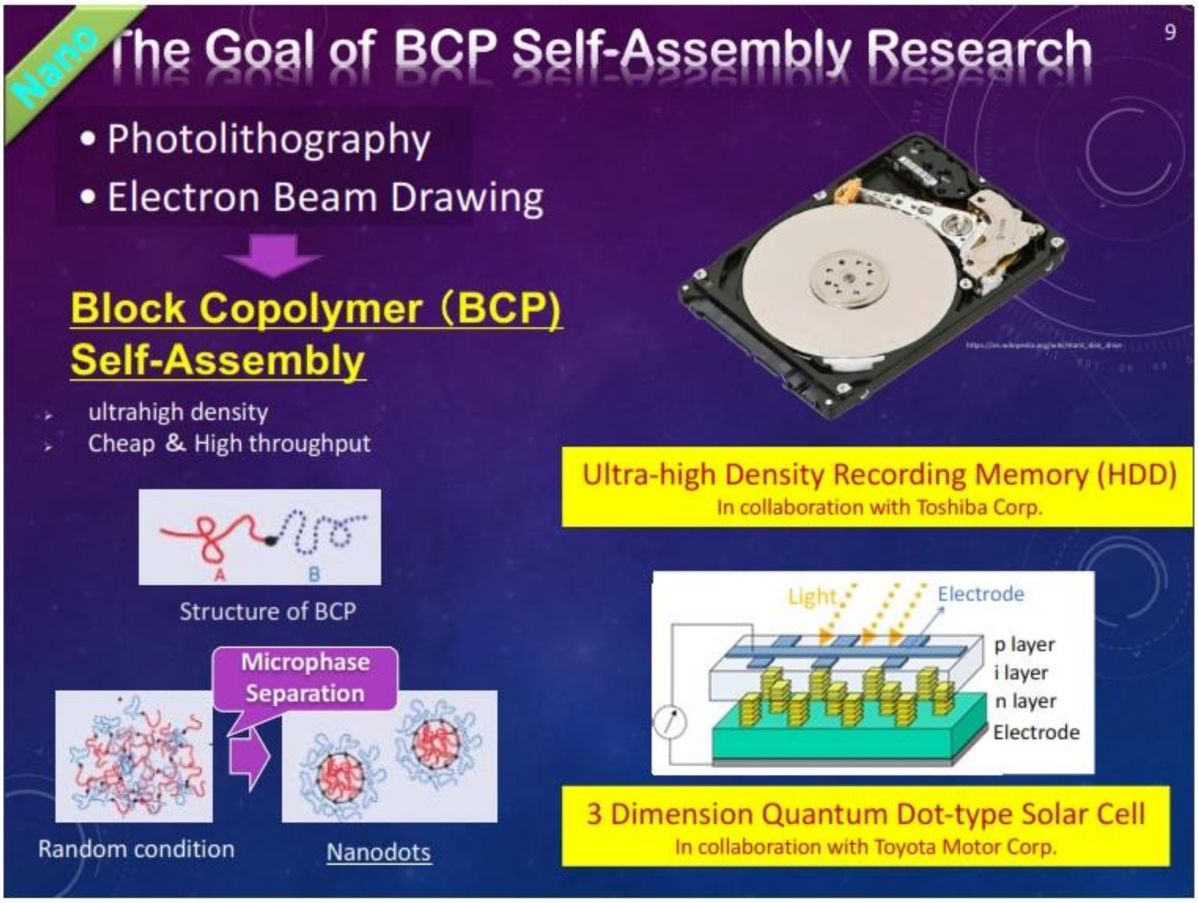

Why nano?
At the nanoscale, strange things happen to materials –
their properties can change.
Optic
physic
thermod ynamic
Lattice structure
Magnetis m
Reactivity
Electric
Surface energy
Mechanic
chemical
Unique Property

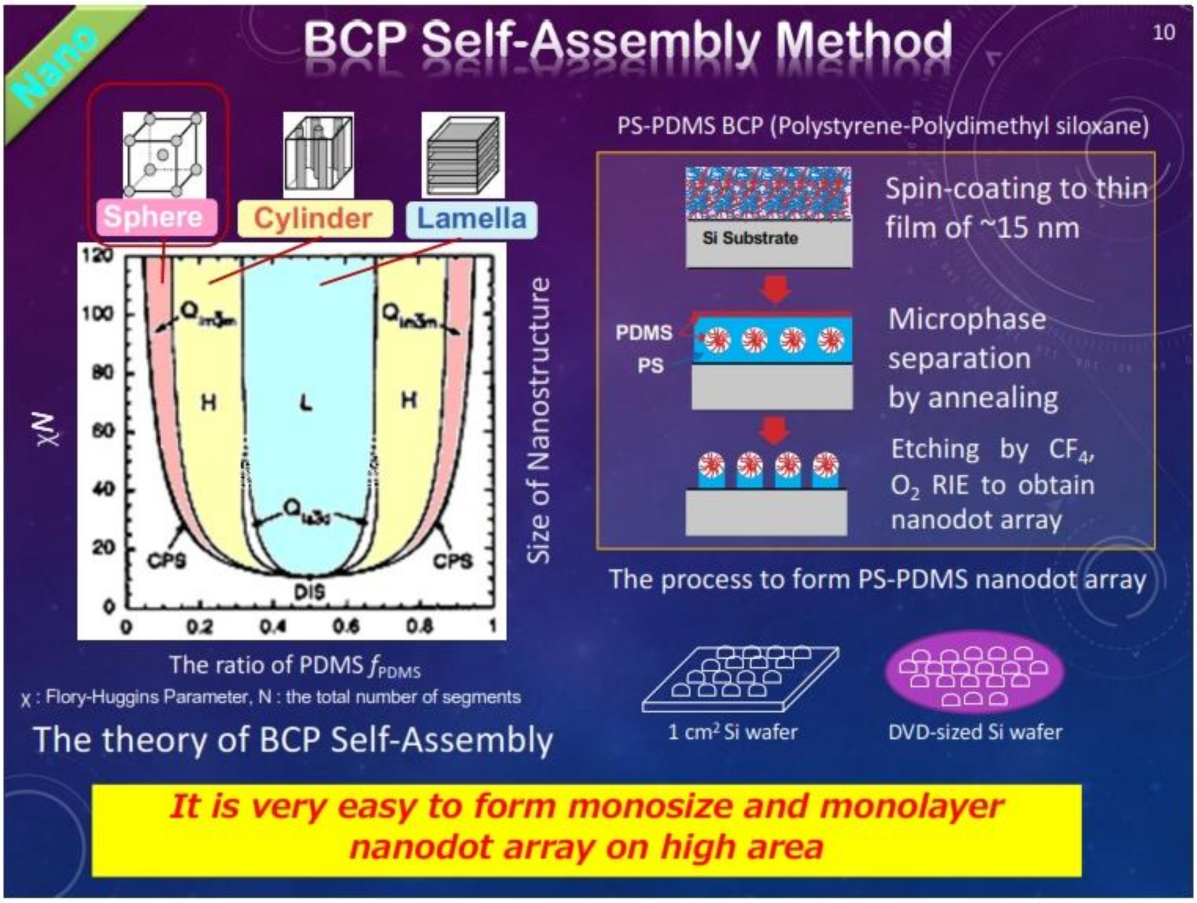

SMALLER → Larger Surface Area
More Reactive → Saving Usage

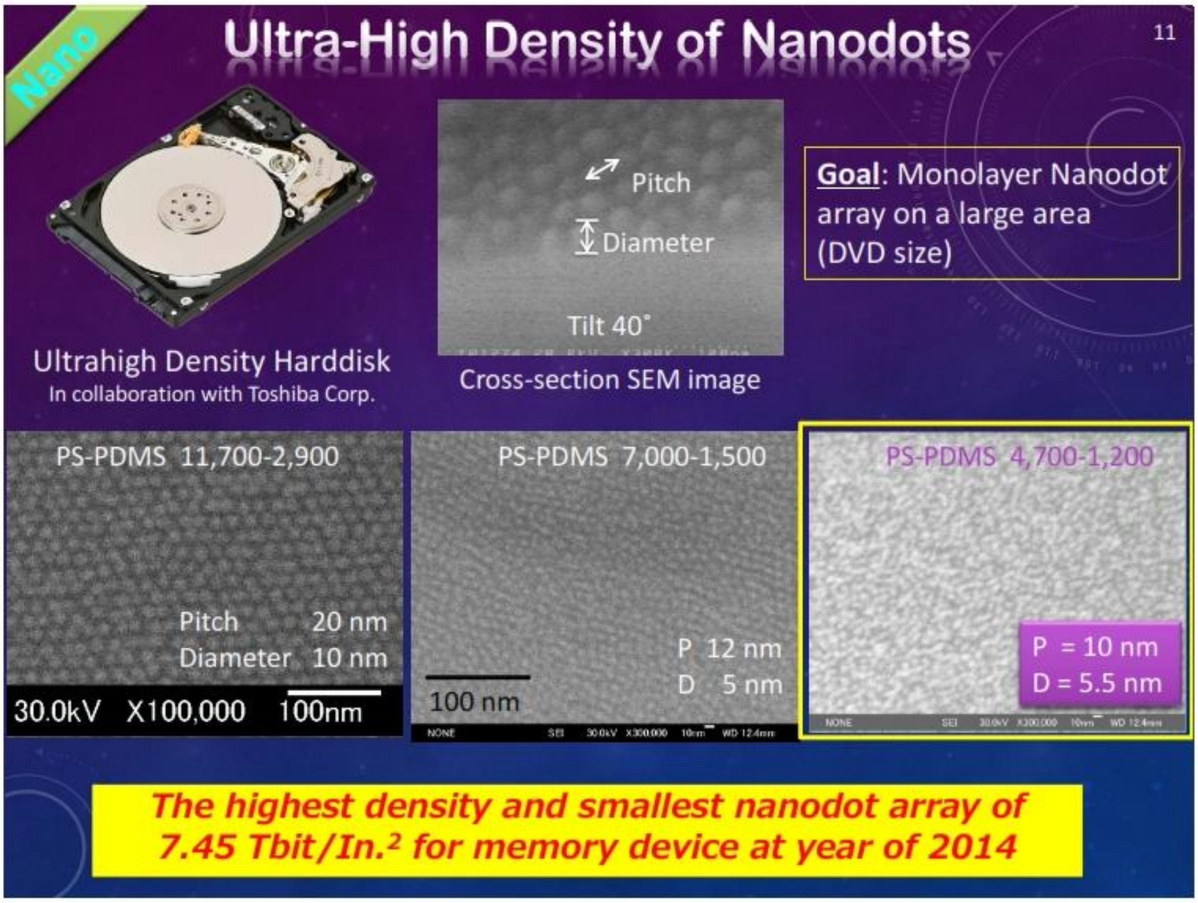
Benefit of Nanotechnology

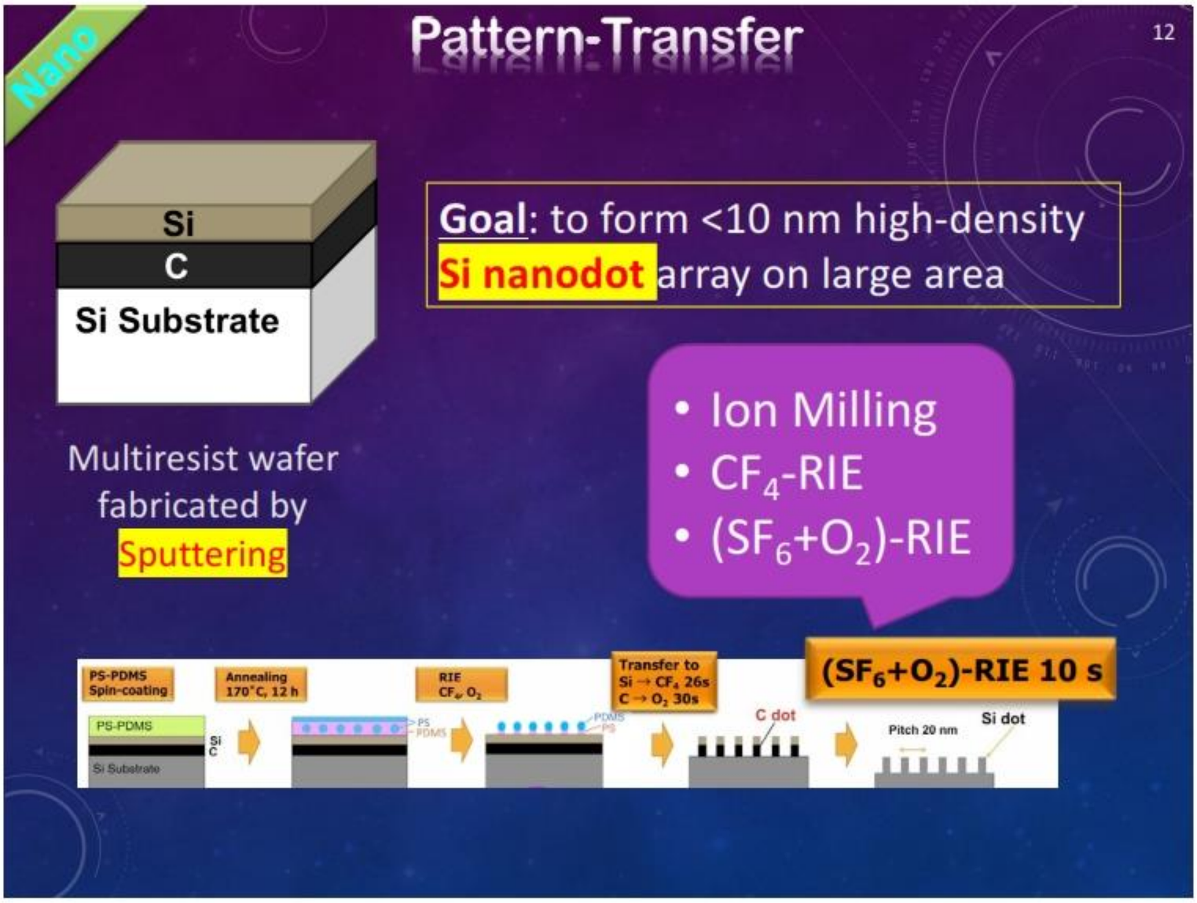
- New-Super Application or Device
- Low Cost and Saving Usage of Materials
- New Science – New Unfold World
- ....

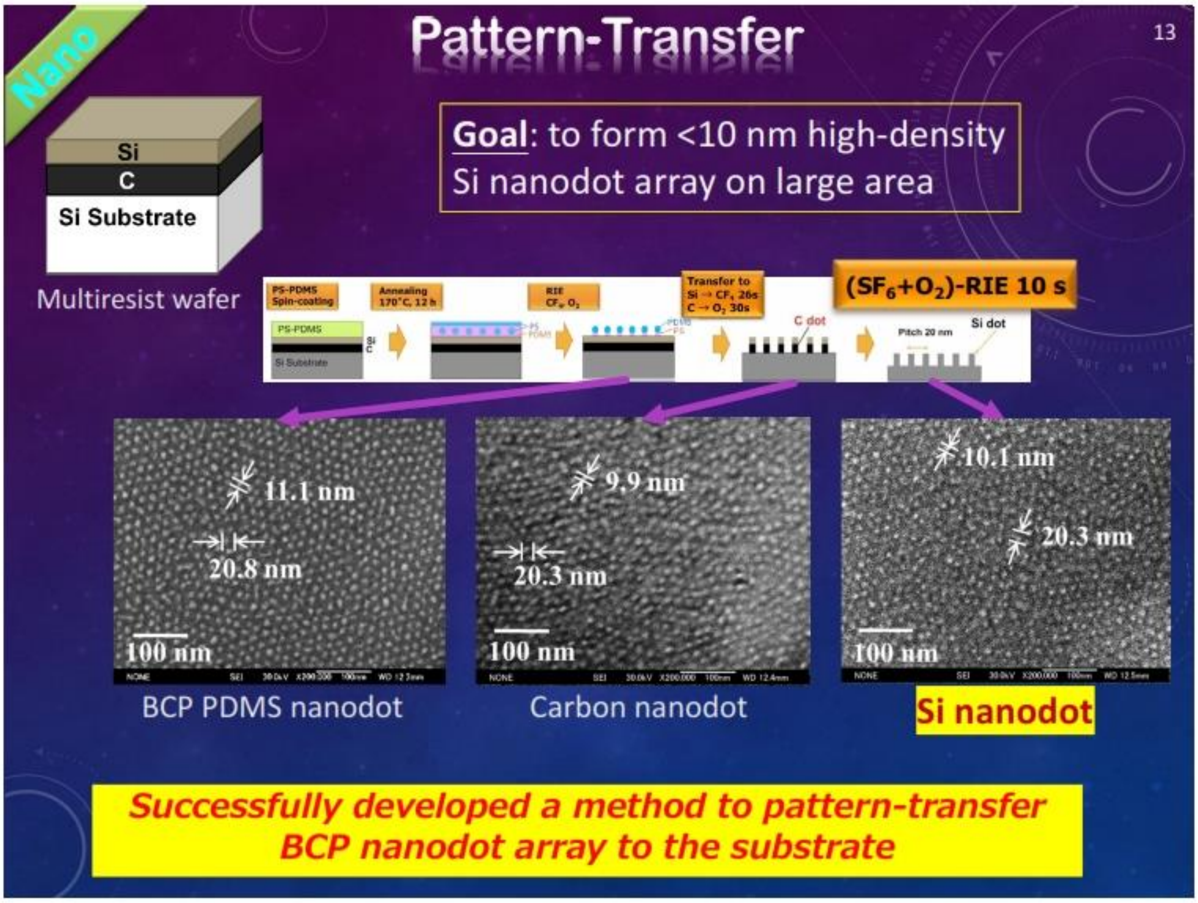


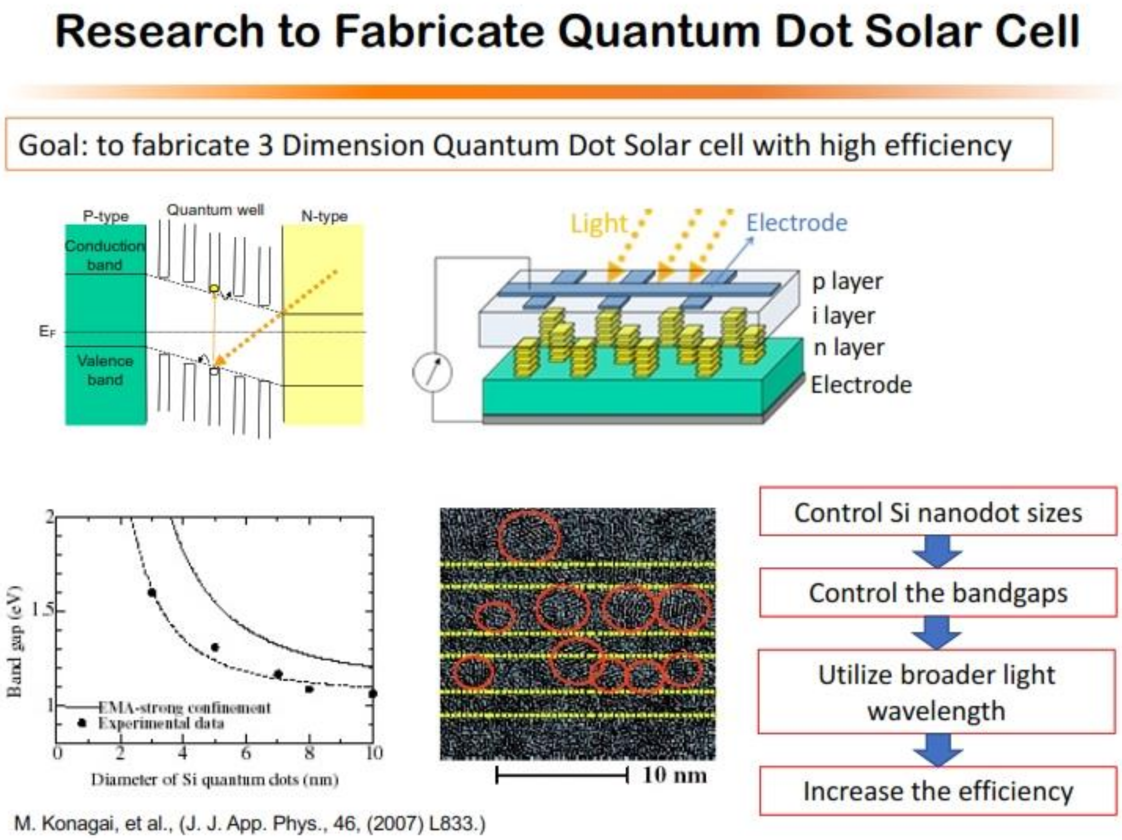

Nano
The Goal of BCP Self-Assembly Research
9
• Photolithography
• Electron Beam Drawing
Block Copolymer (BCP) Self-Assembly
ultrahigh density
Cheap & High throughput
A
B
Structure of BCP
Microphase Separation
Random condition
Nanodots
Ultra-high Density Recording Memory (HDD)
In collaboration with Toshiba Corp.
Light
Electrode
p layer
i layer
n layer
Electrode
3 Dimension Quantum Dot-type Solar Cell
In collaboration with Toyota Motor Corp.

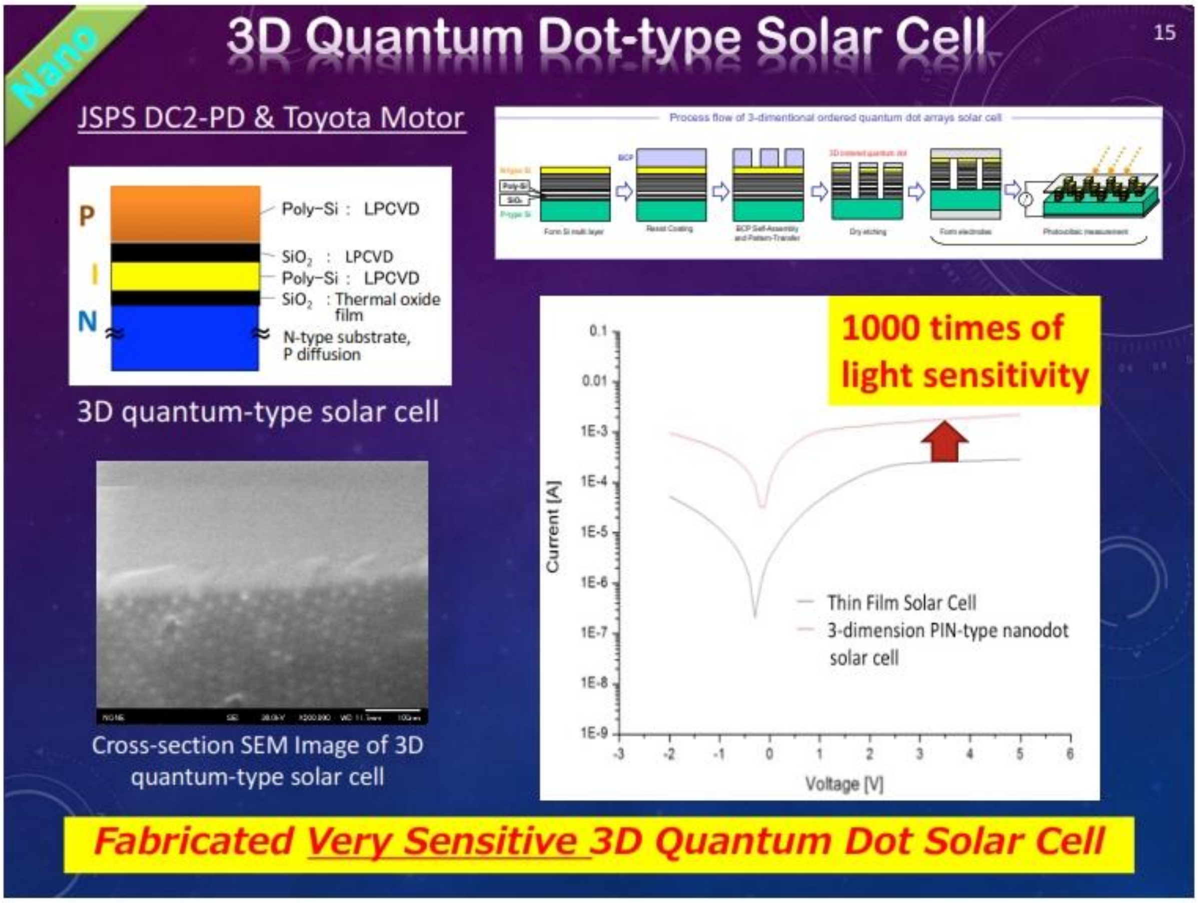

Nano
BCP Self-Assembly Method
10
Sphere
Cylinder
Lamella
χN
H
L
H
CPS
CPS
DIS
Size of Nanostructure
The ratio of PDMS f_{PDMS}
χ : Flory-Huggins Parameter, N : the total number of segments
The theory of BCP Self-Assembly
PS-PDMS BCP (Polystyrene-Polydimethyl siloxane)
Si Substrate
Spin-coating to thin film of ~15 nm
PDMS
PS
Microphase separation by annealing
Etching by CF_4, O_2 RIE to obtain nanodot array
The process to form PS-PDMS nanodot array
1 cm^2 Si wafer
DVD-sized Si wafer
It is very easy to form monosize and monolayer nanodot array on high area

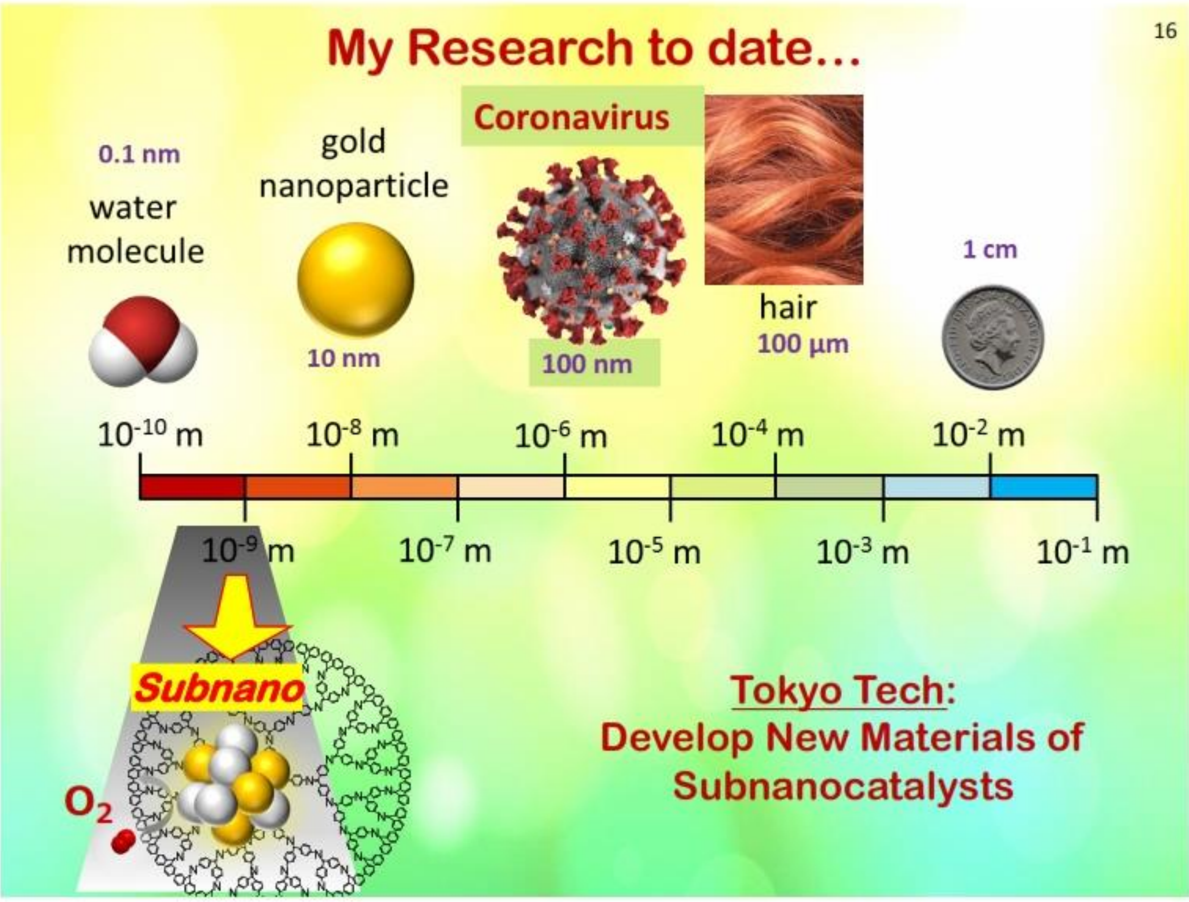

Nano
Ultra-High Density of Nanodots
11
Pitch
Diameter
Tilt 40°
Goal: Monolayer Nanodot array on a large area (DVD size)
Ultrahigh Density Harddisk
In collaboration with Toshiba Corp.
Cross-section SEM image
PS-PDMS 11,700-2,900
Pitch 20 nm
Diameter 10 nm
30.0kV X100,000 100nm
PS-PDMS 7,000-1,500
P 12 nm
D 5 nm
100 nm
PS-PDMS 4,700-1,200
P = 10 nm
D = 5.5 nm
The highest density and smallest nanodot array of 7.45 Tbit/In.2 for memory device at year of 2014

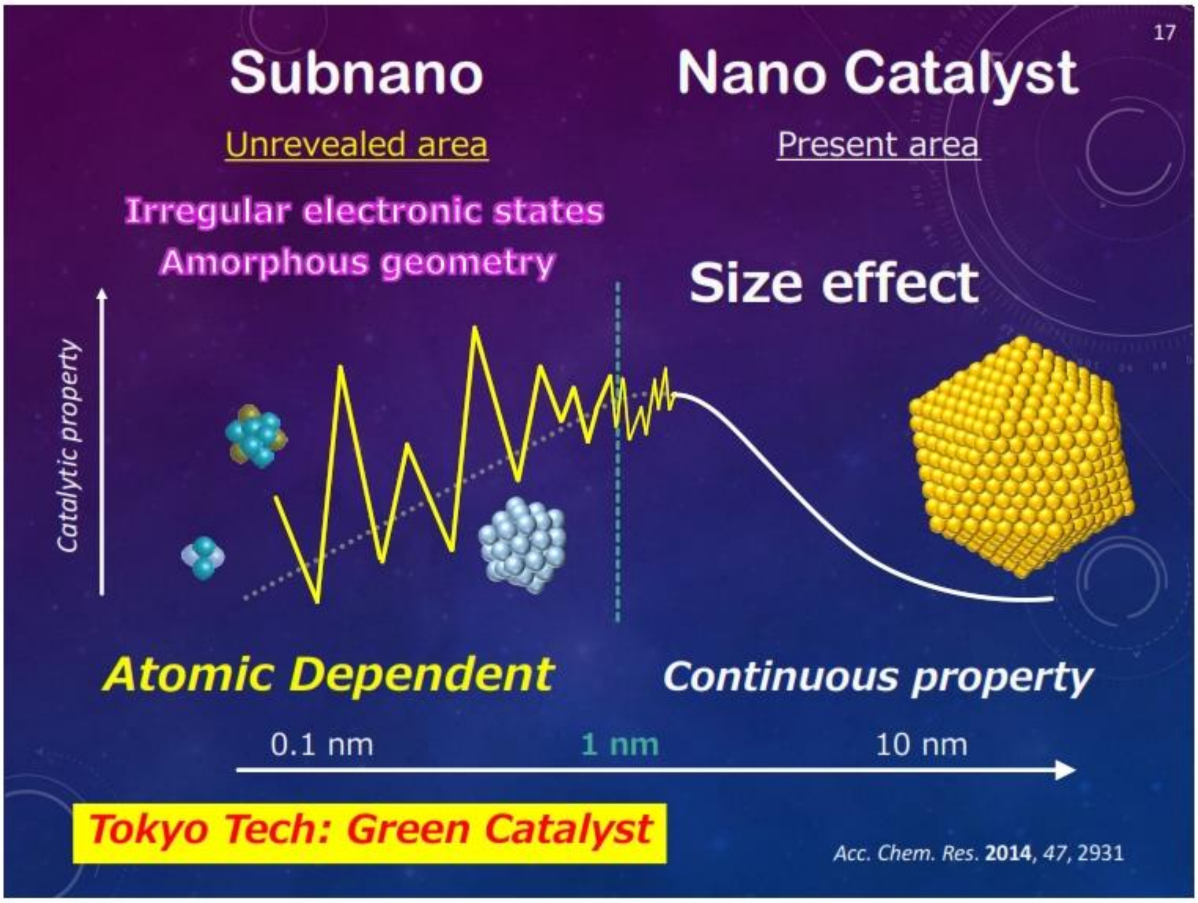

Nano
Pattern-Transfer
12
Si
C
Si Substrate
Goal: to form <10 nm high-density Si nanodot array on large area
Multiresist wafer fabricated by Sputtering
• Ion Milling
• CF4-RIE
• (SF6+O2)-RIE
(SF6+O2)-RIE 10 s
PS-PDMS Spin-coating
Annealing 170°C, 12 h
RIE CF4, O2
Transfer to Si → CF4 26s C → O2 30s
PS-PDMS
Si Substrate
C dot
Si dot
Pitch 20 nm

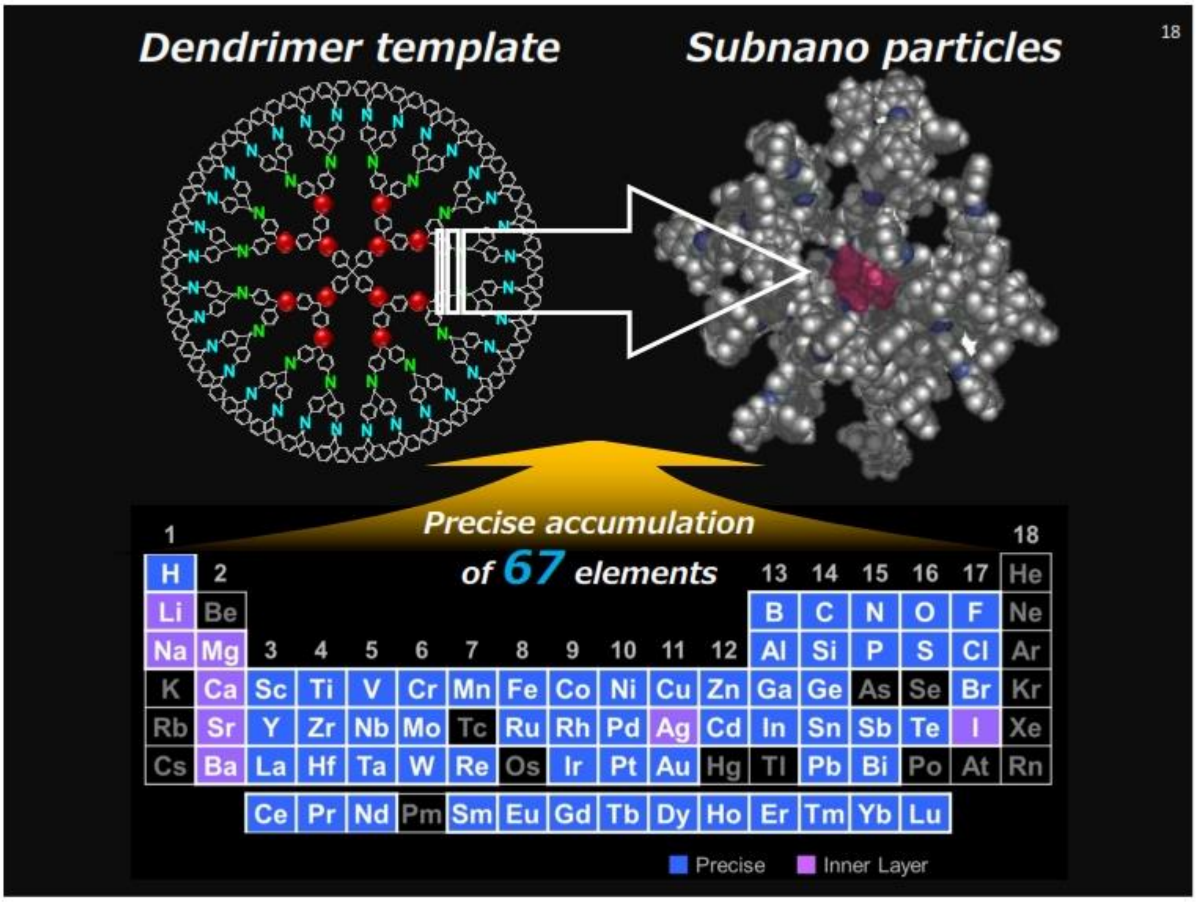

Pattern-Transfer
13
Nano
Goal: to form <10 nm high-density Si nanodot array on large area
Si
C
Si Substrate
Multiresist wafer
(SF6+O2)-RIE 10 s
11.1 nm
20.8 nm
100 nm
9.9 nm
20.3 nm
100 nm
10.1 nm
20.3 nm
100 nm
BCP PDMS nanodot
Carbon nanodot
Si nanodot
Successfully developed a method to pattern-transfer BCP nanodot array to the substrate

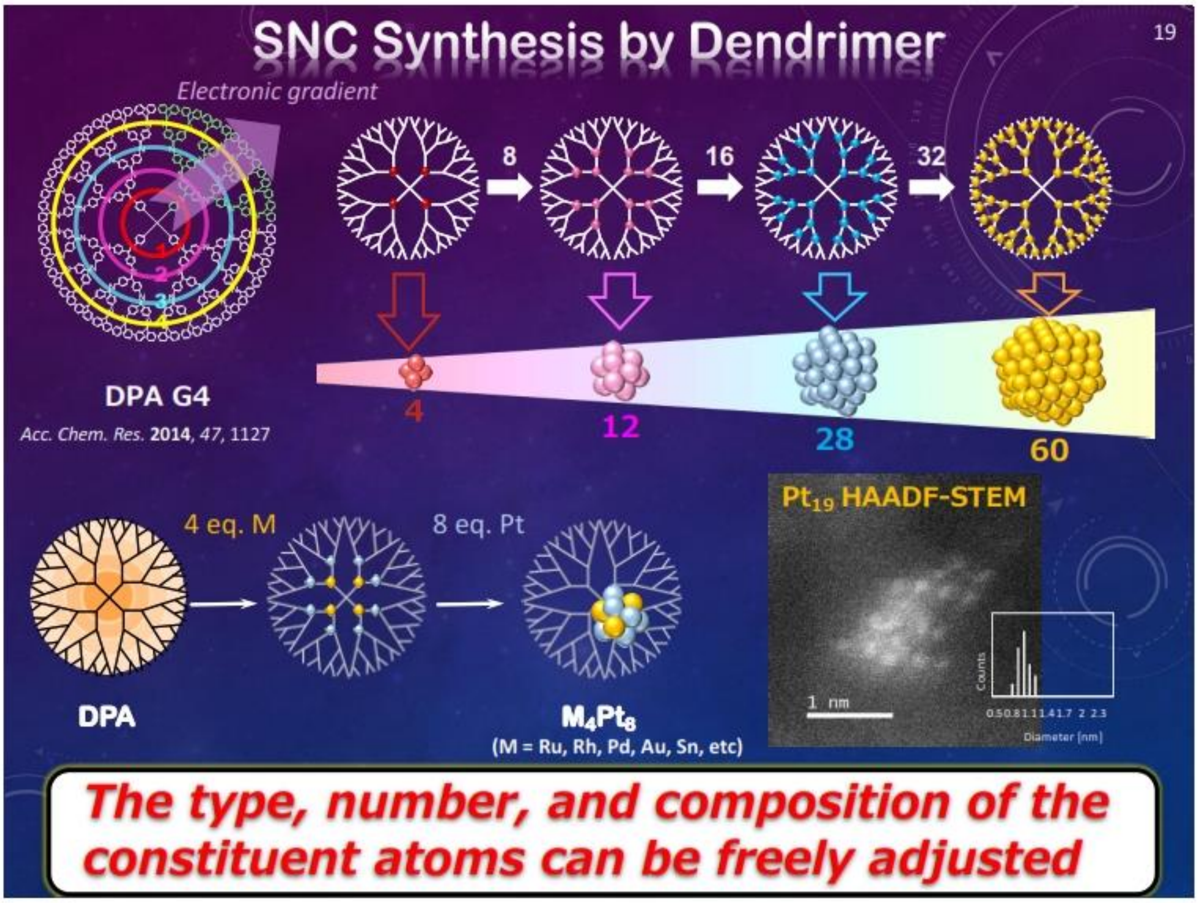

Research to Fabricate Quantum Dot Solar Cell
Goal: to fabricate 3 Dimension Quantum Dot Solar cell with high efficiency
P-type
Quantum well
N-type
Conduction band
Valence band
Light
Electrode
p layer
i layer
n layer
Electrode
Band gap (eV)
Diameter of Si quantum dots (nm)
EMA-strong confinement
Experimental data
10 nm
Control Si nanodot sizes
Control the bandgaps
Utilize broader light wavelength
Increase the efficiency
M. Konagai, et al., (J. J. App. Phys., 46, (2007) L833.)

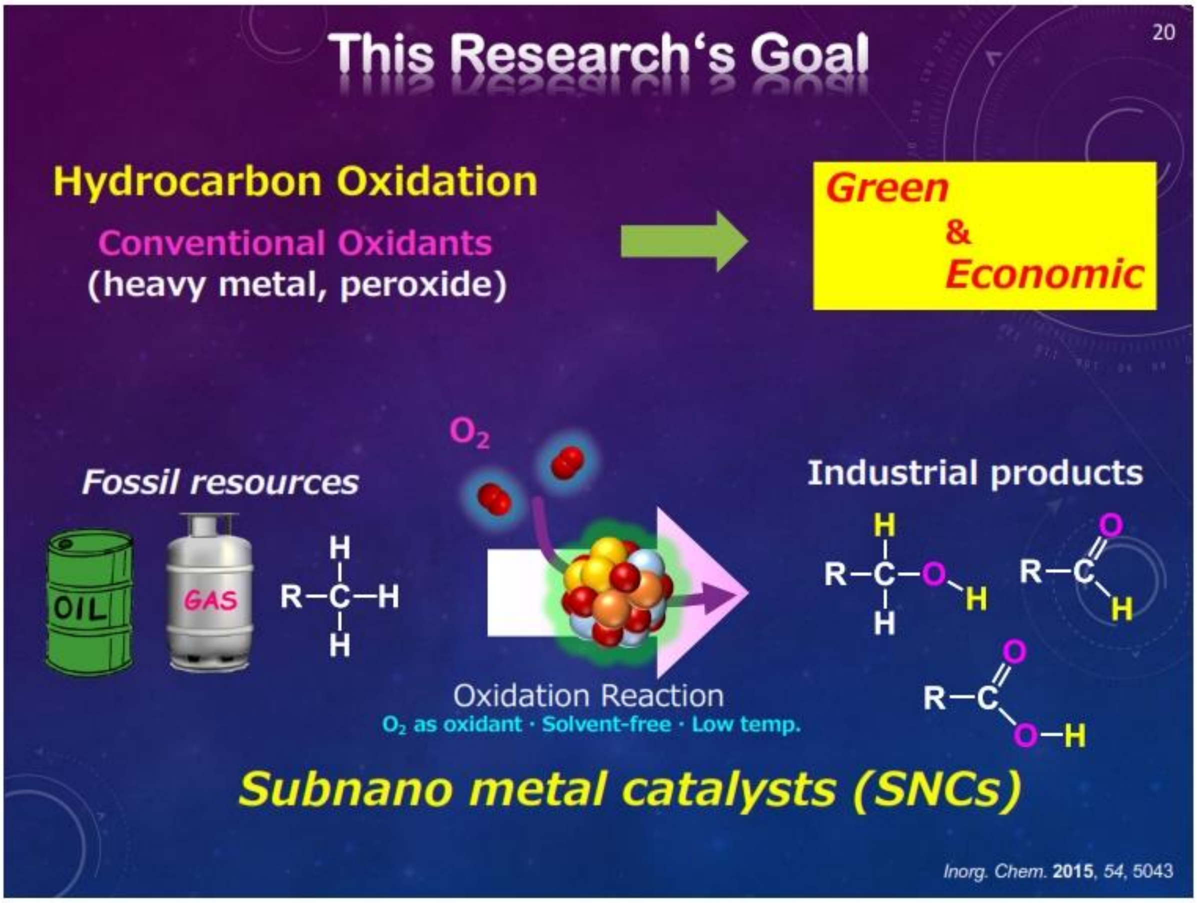

Nano
3D Quantum Dot-type Solar Cell
15
JSPS DC2-PD & Toyota Motor
P
I
N
Poly-Si : LPCVD
SiO2 : LPCVD
Poly-Si : LPCVD
SiO2 : Thermal oxide film
N-type substrate, P diffusion
3D quantum-type solar cell
Cross-section SEM Image of 3D quantum-type solar cell
Process flow of 3-dimentional ordered quantum dot arrays solar cell
1000 times of light sensitivity
Current [A]
Voltage [V]
Thin Film Solar Cell
3-dimension PIN-type nanodot solar cell
Fabricated Very Sensitive 3D Quantum Dot Solar Cell

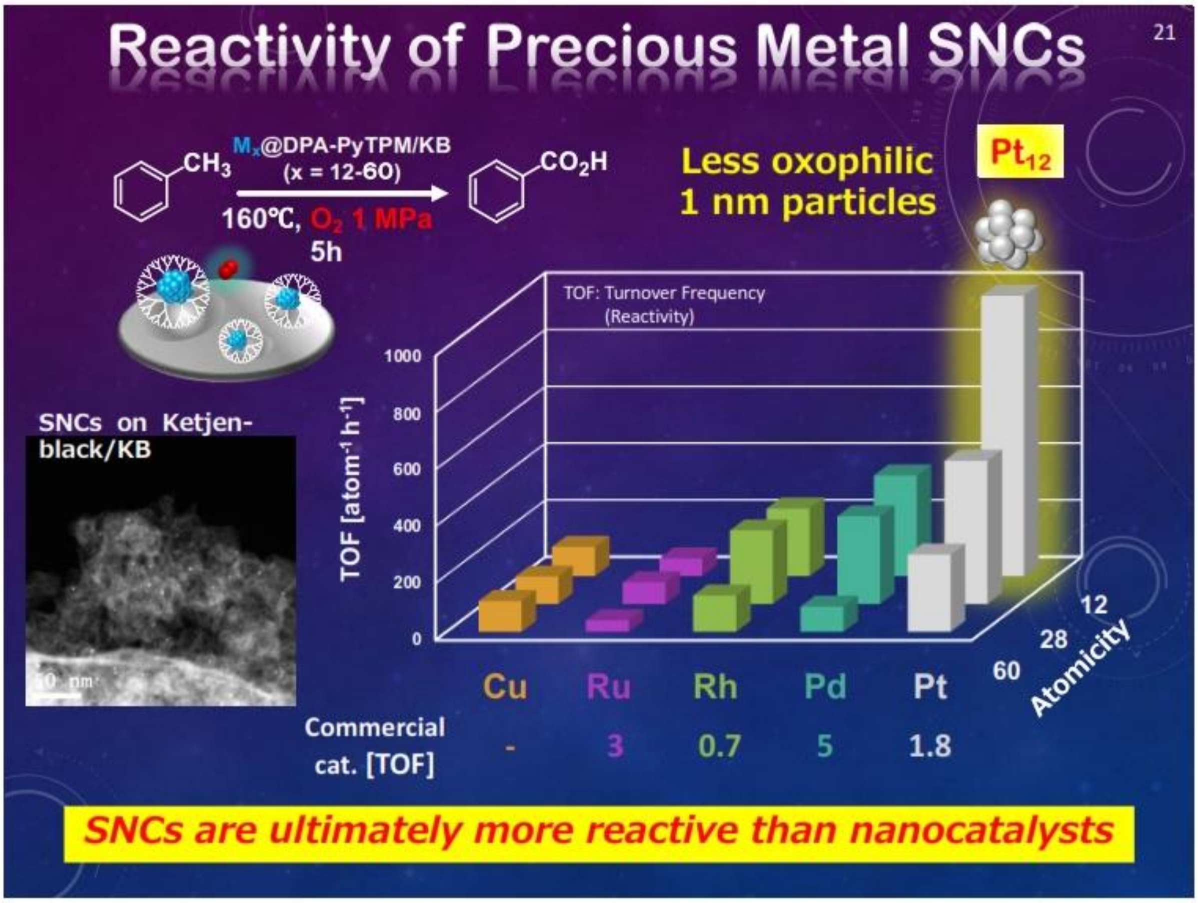

My Research to date…
16
0.1 nm
water molecule
gold nanoparticle
10 nm
Coronavirus
100 nm
hair
100 µm
1 cm
10-10 m
10-8 m
10-6 m
10-4 m
10-2 m
10-9 m
10-7 m
10-5 m
10-3 m
10-1 m
Subnano
O2
Tokyo Tech:
Develop New Materials of Subnanocatalysts

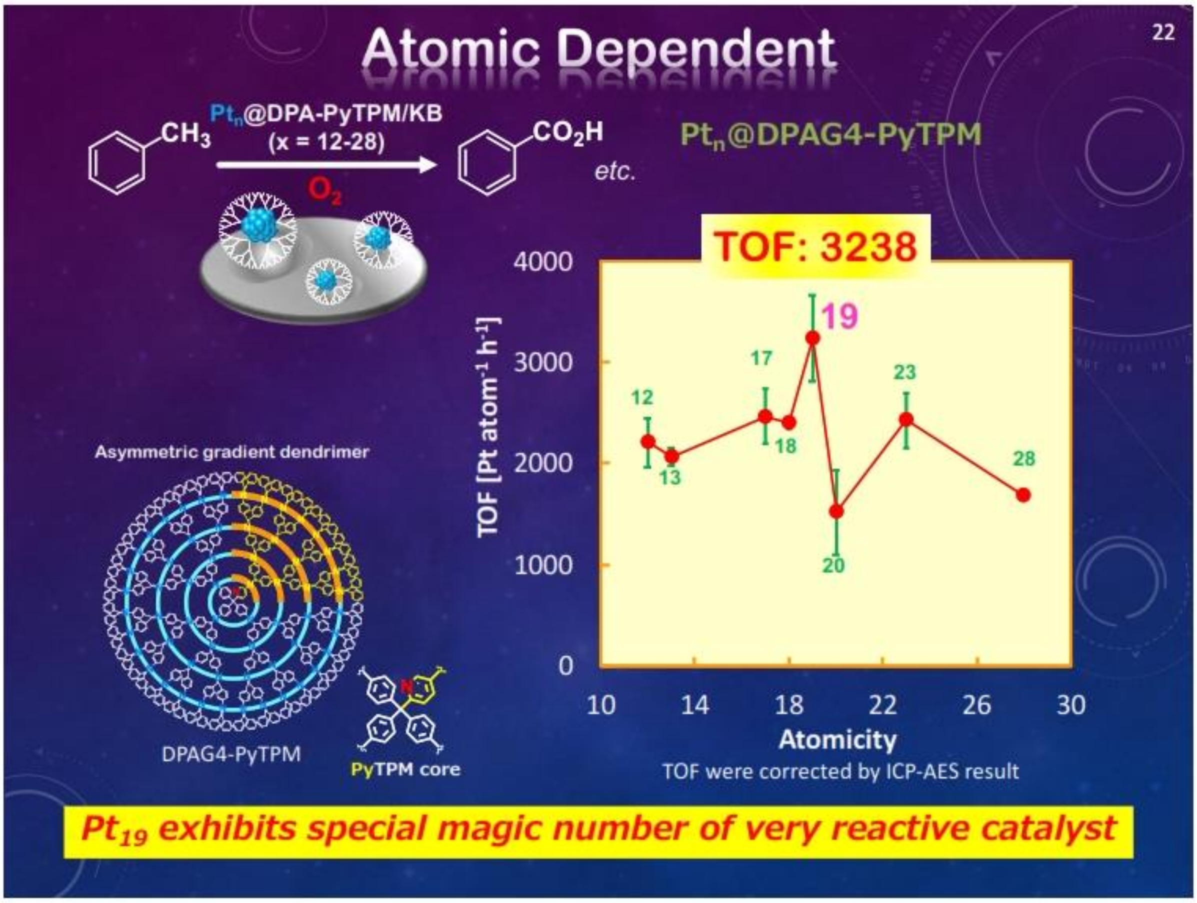

17
Subnano
Nano Catalyst
Unrevealed area
Present area
Irregular electronic states
Amorphous geometry
Size effect
Catalytic property
Atomic Dependent
Continuous property
0.1 nm
1 nm
10 nm
Tokyo Tech: Green Catalyst
Acc. Chem. Res. 2014, 47, 2931

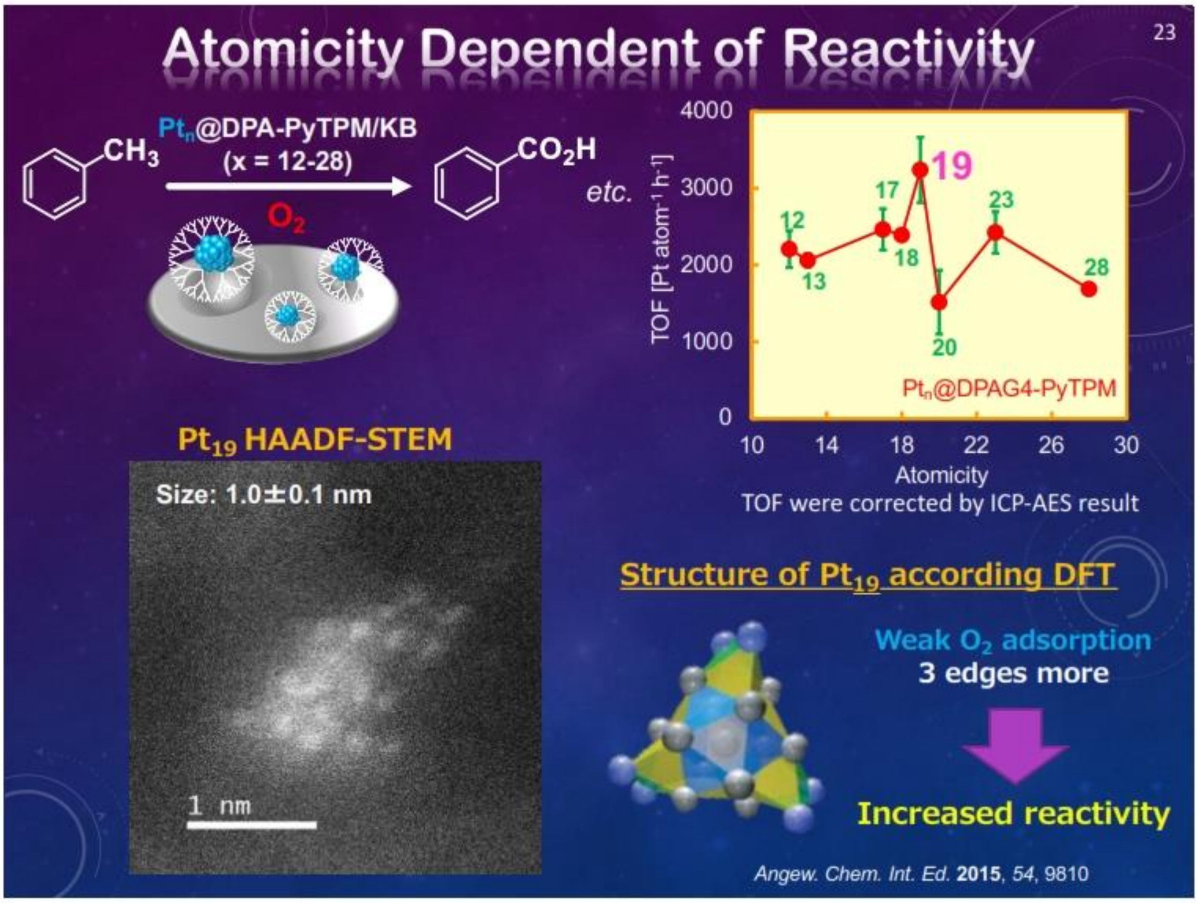

18
Dendrimer template
Subnano particles
Precise accumulation
of 67 elements
Precise
Inner Layer

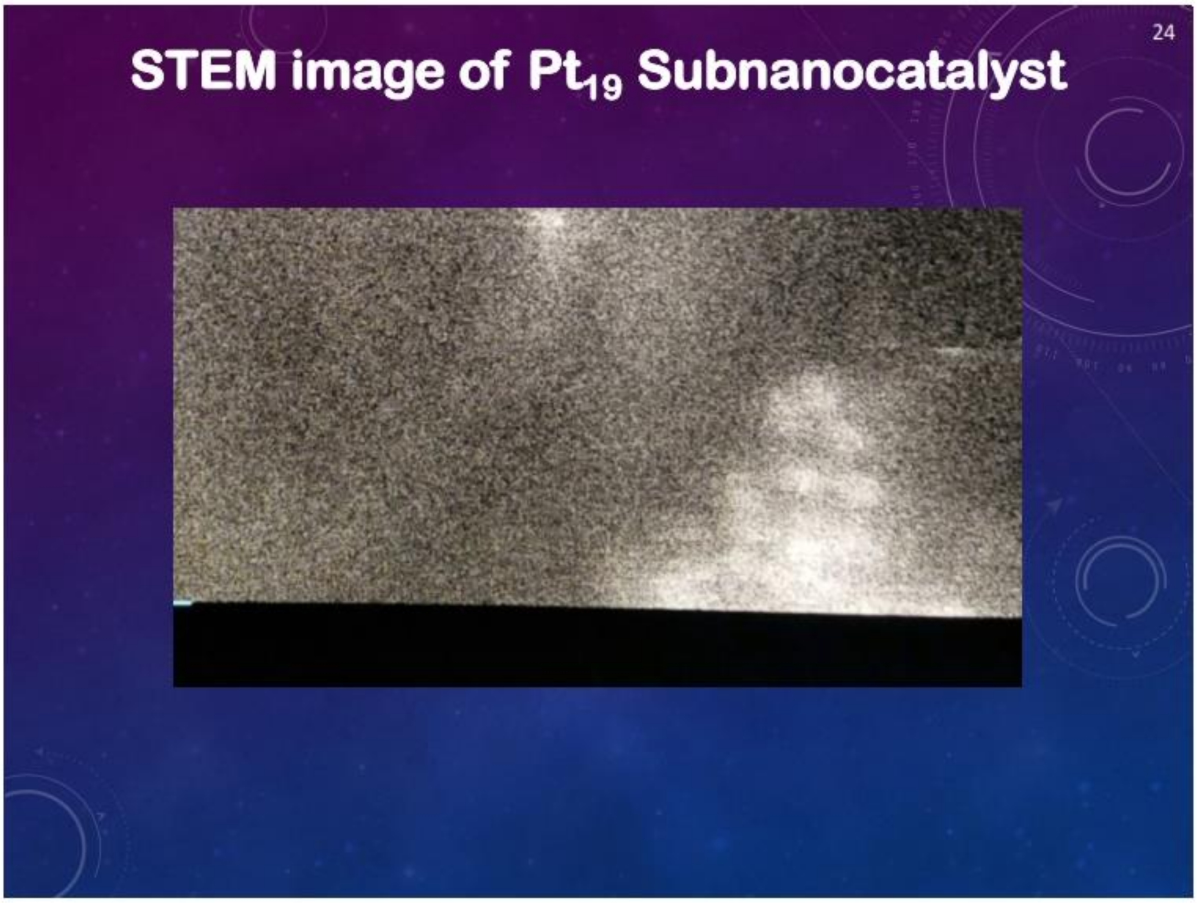

SNC Synthesis by Dendrimer
19
Electronic gradient
8
16
32
DPA G4
Acc. Chem. Res. 2014, 47, 1127
4
12
28
60
Pt19 HAADF-STEM
4 eq. M
8 eq. Pt
DPA
M4Pt8
(M = Ru, Rh, Pd, Au, Sn, etc)
1 nm
The type, number, and composition of the constituent atoms can be freely adjusted

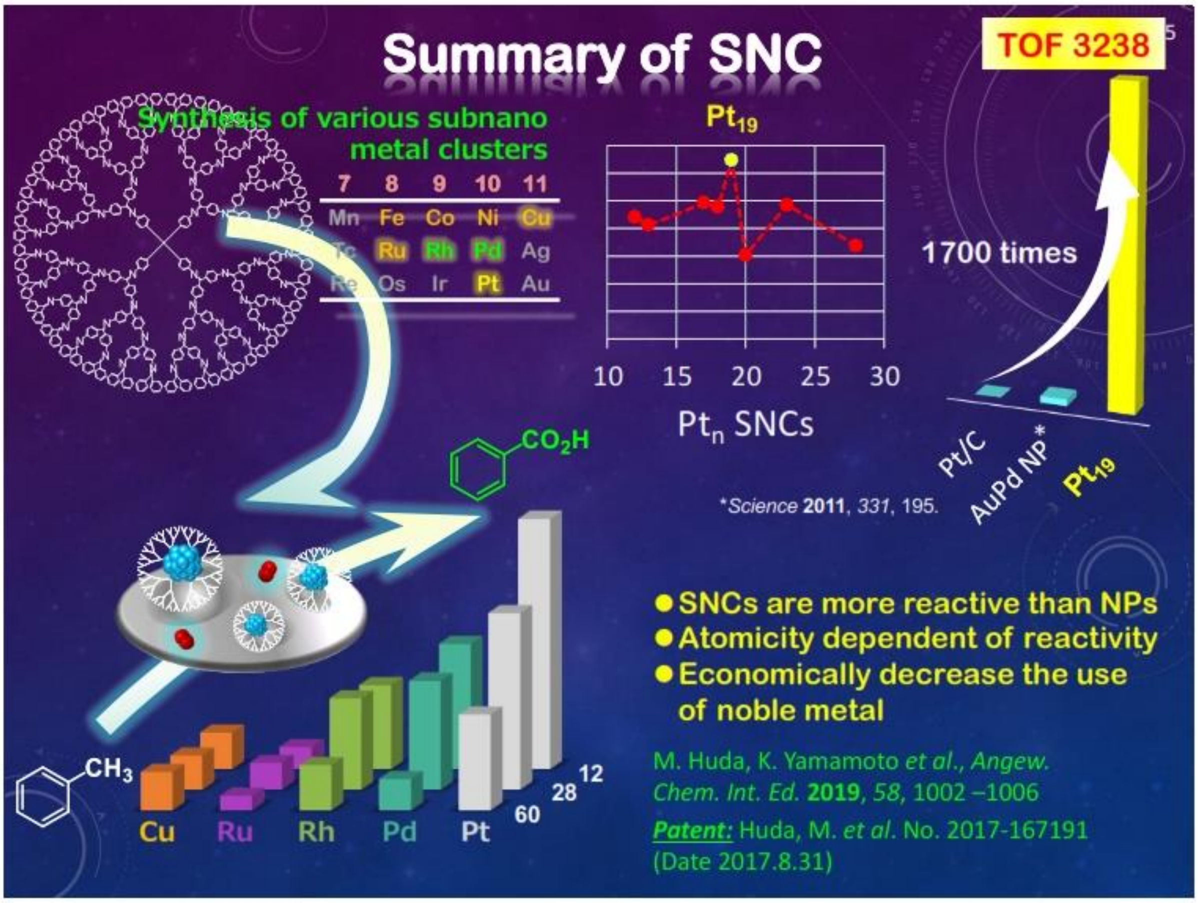

This Research's Goal
20
Hydrocarbon Oxidation
Conventional Oxidants
(heavy metal, peroxide)
Green
&
Economic
O2
Fossil resources
OIL
GAS
Industrial products
Oxidation Reaction
O2 as oxidant · Solvent-free · Low temp.
Subnano metal catalysts (SNCs)
Inorg. Chem. 2015, 54, 5043

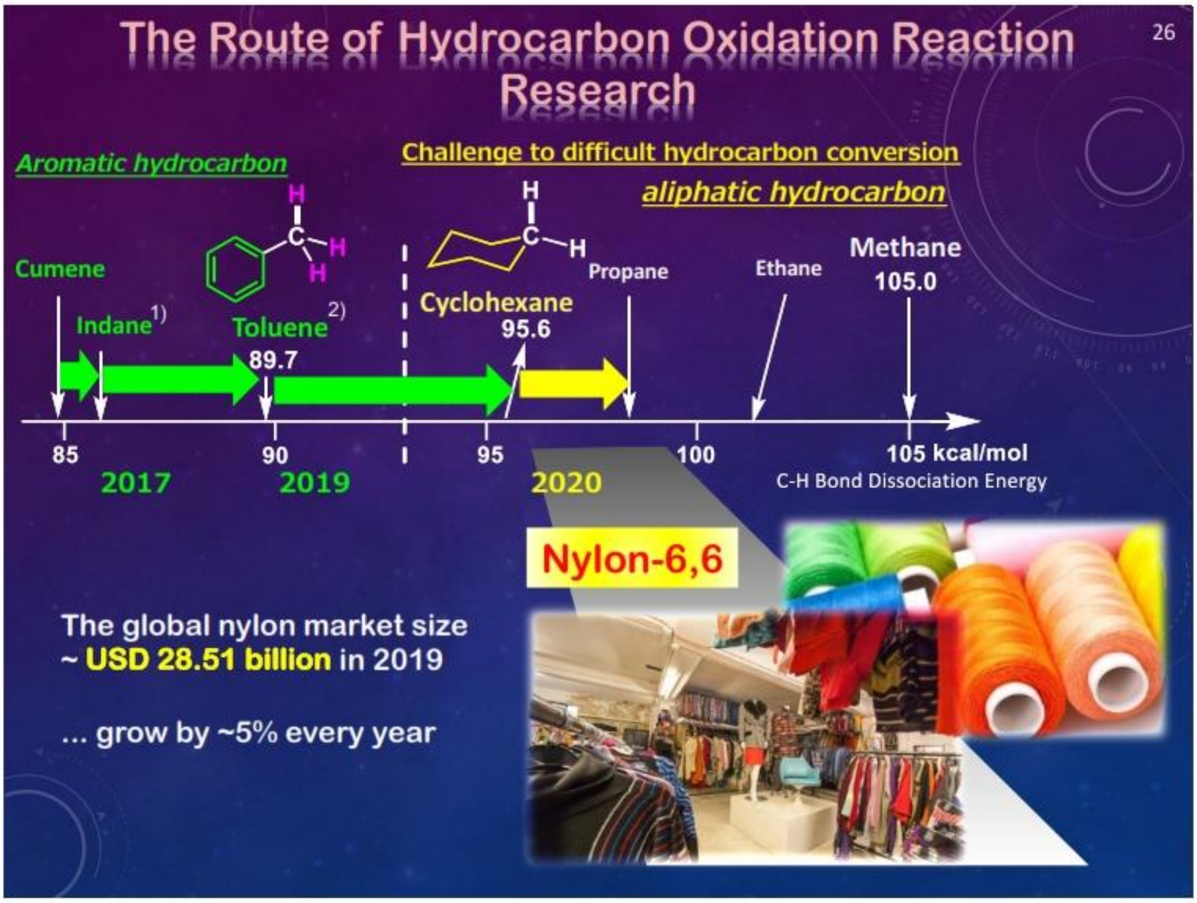

Reactivity of Precious Metal SNCs
21
Mx@DPA-PyTPM/KB
(x = 12-60)
160℃, O2 1 MPa
5h
CH3
CO2H
Less oxophilic
1 nm particles
Pt12
TOF: Turnover Frequency
(Reactivity)
TOF [atom-1 h-1]
1000
800
600
400
200
0
SNCs on Ketjen-black/KB
Cu Ru Rh Pd Pt
12
28
60
Atomicity
Commercial cat. [TOF]
- 3 0.7 5 1.8
SNCs are ultimately more reactive than nanocatalysts

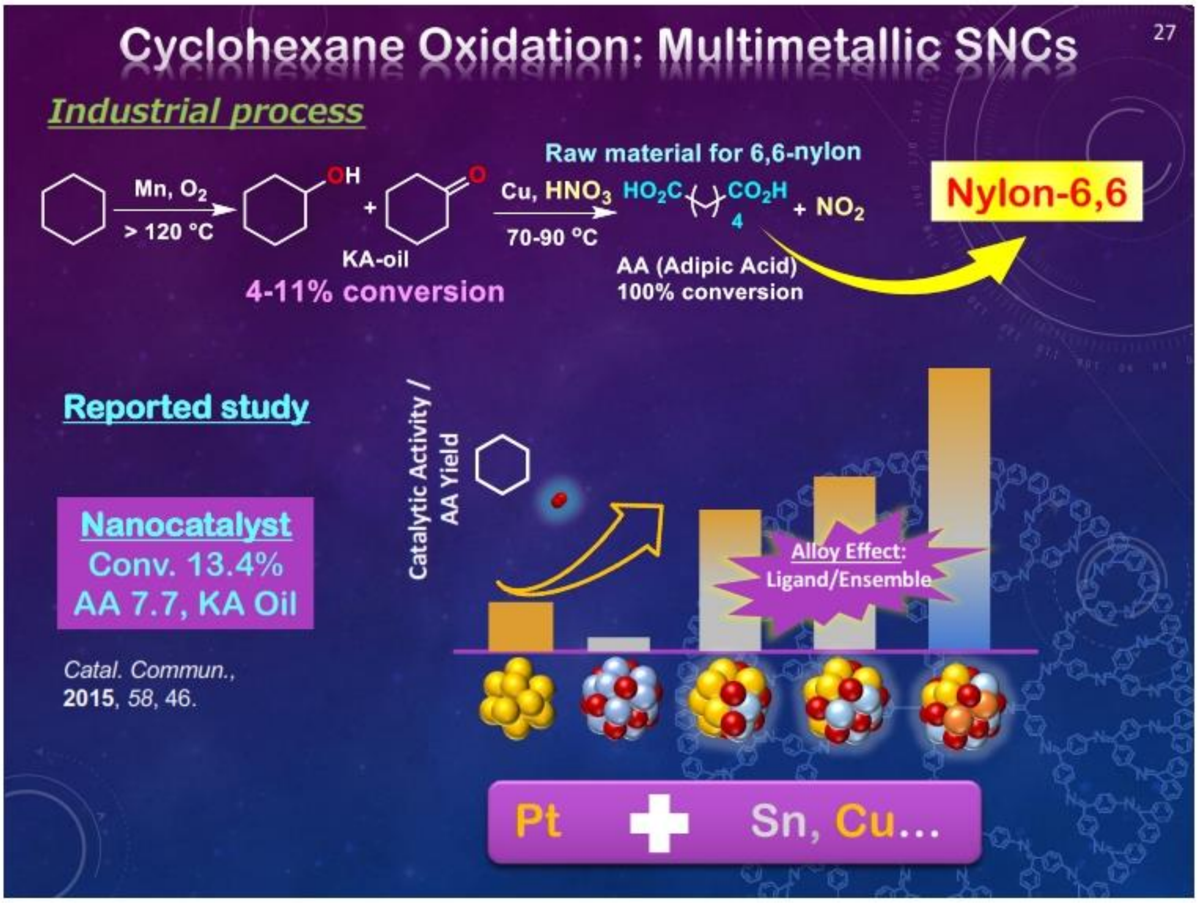

Atomic Dependent
22
Ptn@DPA-PyTPM/KB
(x = 12-28)
O2
CH3
CO2H
etc.
Ptn@DPAG4-PyTPM
TOF: 3238
TOF [Pt atom-1 h-1]
4000
3000
2000
1000
0
12
13
17
18
19
20
23
28
10 14 18 22 26 30
Atomicity
TOF were corrected by ICP-AES result
Asymmetric gradient dendrimer
DPAG4-PyTPM
PyTPM core
Pt19 exhibits special magic number of very reactive catalyst

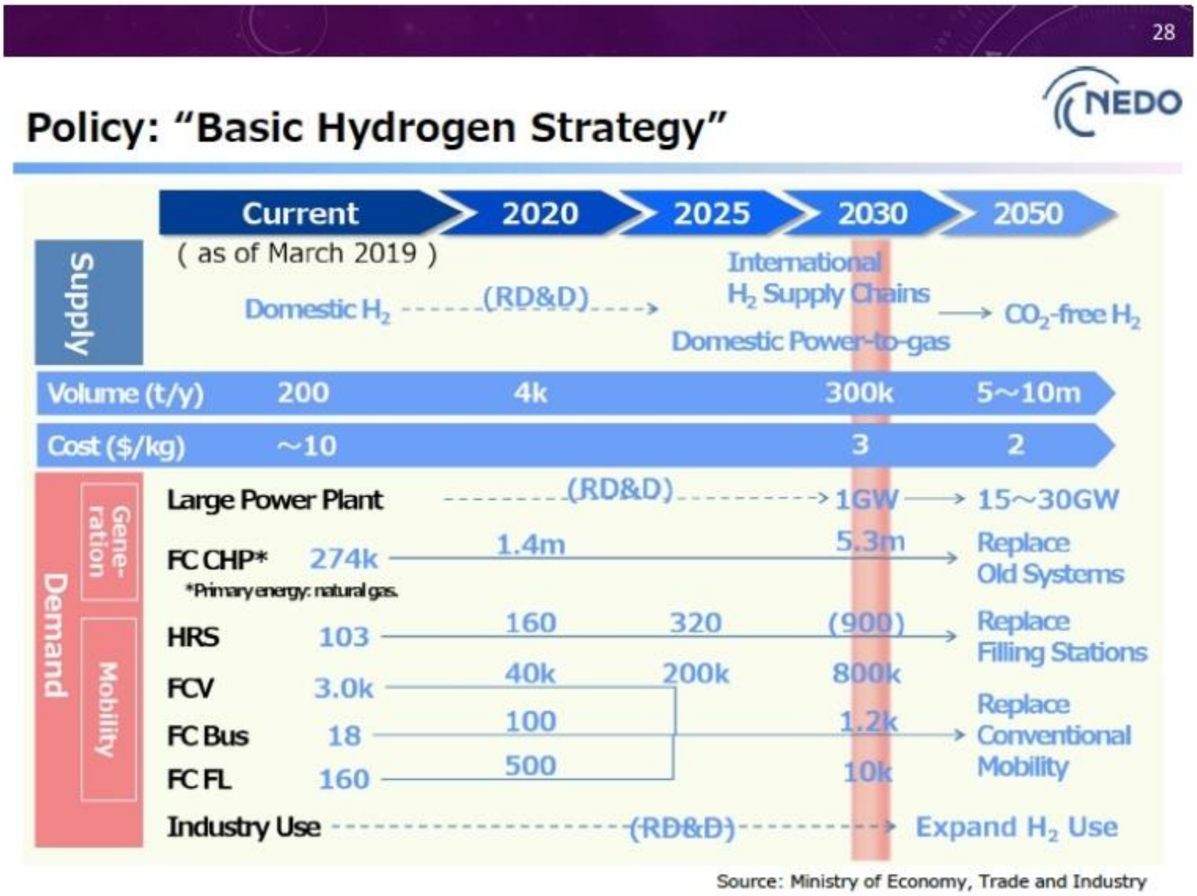

Atomicity Dependent of Reactivity
23
Pt$_n$@DPA-PyTPM/KB
(x = 12-28)
CH$_3$
CO$_2$H
etc.
O$_2$
TOF [Pt atom^{-1} h^{-1}]
Atomicity
Pt$_n$@DPAG4-PyTPM
TOF were corrected by ICP-AES result
Pt$_{19}$ HAADF-STEM
Size: 1.0±0.1 nm
1 nm
Structure of Pt$_{19}$ according DFT
Weak O$_2$ adsorption
3 edges more
Increased reactivity
Angew. Chem. Int. Ed. 2015, 54, 9810

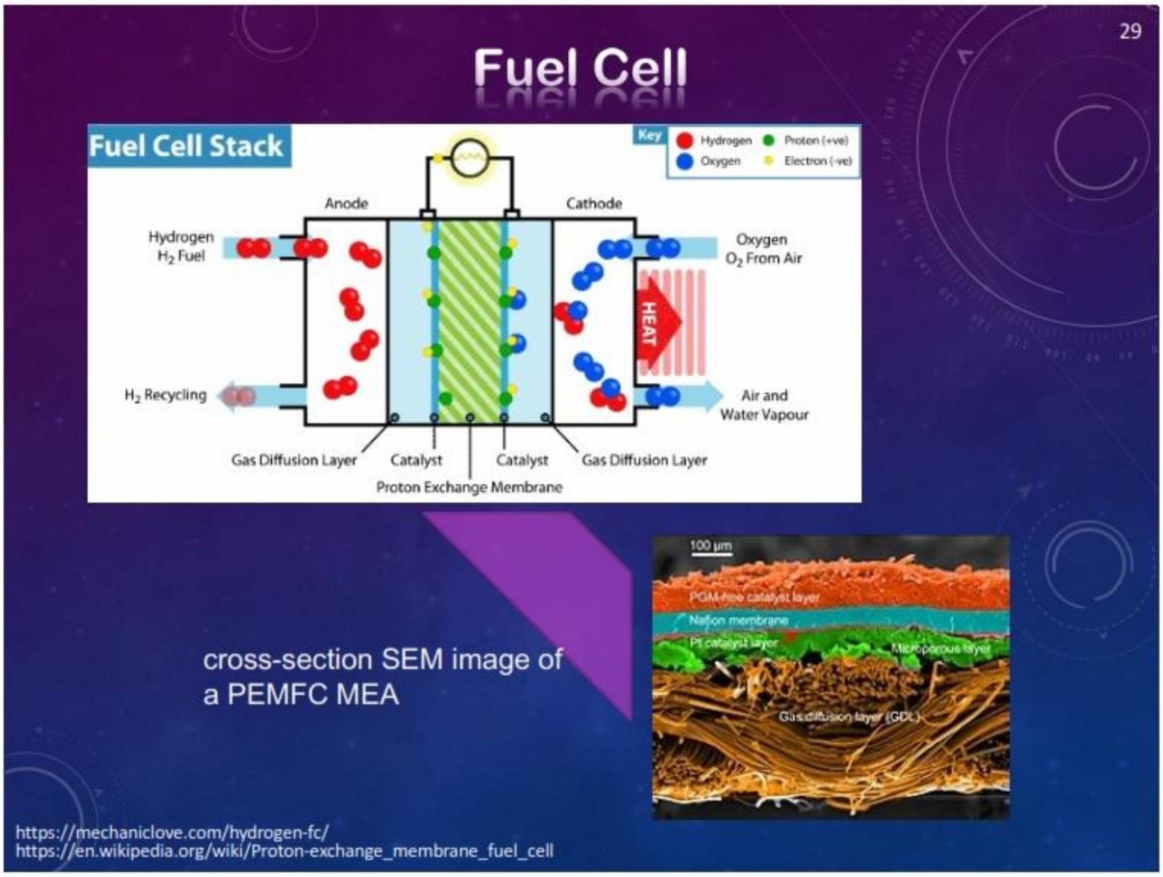

STEM image of Pt$_{19}$ Subnanocatalyst
24

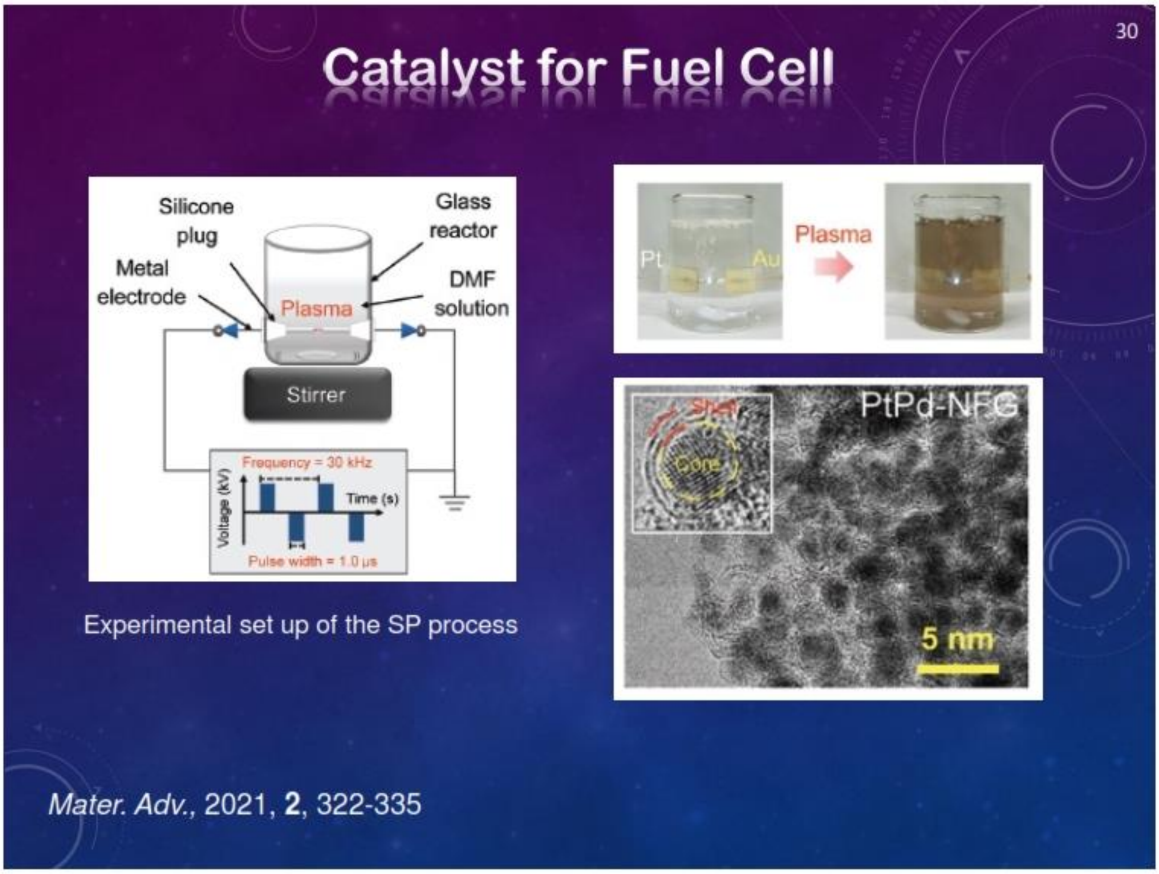

Summary of SNC
TOF 3238
Synthesis of various subnano metal clusters
7 8 9 10 11
Mn Fe Co Ni Cu
Ru Rh Pd Ag
Os Ir Pt Au
Pt19
10 15 20 25 30
Ptn SNCs
1700 times
Pt/C
AuPd NP*
Pt19
*Science 2011, 331, 195.
CO2H
CH3
Cu Ru Rh Pd Pt
60 28 12
●SNCs are more reactive than NPs
●Atomicity dependent of reactivity
●Economically decrease the use of noble metal
M. Huda, K. Yamamoto et al., Angew. Chem. Int. Ed. 2019, 58, 1002 –1006
Patent: Huda, M. et al. No. 2017-167191 (Date 2017.8.31)


The Route of Hydrocarbon Oxidation Reaction Research
26
Aromatic hydrocarbon
Challenge to difficult hydrocarbon conversion
aliphatic hydrocarbon
Cumene
Indane 1)
Toluene 2)
89.7
Cyclohexane
95.6
Propane
Ethane
Methane
105.0
85 90 95 100 105 kcal/mol
C-H Bond Dissociation Energy
2017 2019 2020
Nylon-6,6
The global nylon market size ~ USD 28.51 billion in 2019
... grow by ~5% every year


Cyclohexane Oxidation: Multimetallic SNCs
27
Industrial process
Mn, O_2
> 120 °C
OH
+
O
KA-oil
4-11% conversion
Raw material for 6,6-nylon
Cu, HNO_3
70-90 °C
HO_2C CO_2H 4
+ NO_2
AA (Adipic Acid)
100% conversion
Nylon-6,6
Reported study
Nanocatalyst
Conv. 13.4%
AA 7.7, KA Oil
Catal. Commun., 2015, 58, 46.
Catalytic Activity / AA Yield
Alloy Effect:
Ligand/Ensemble
Pt
Sn, Cu...


28
NEDO
Policy: "Basic Hydrogen Strategy"
Current
2020
2025
2030
2050
(as of March 2019)
Supply
Domestic H_2
(RD&D)
International
H_2 Supply Chains
Domestic Power-to-gas
CO_2-free H_2
Volume (t/y) 200 4k 300k 5~10m
Cost ($/kg) ~10 3 2
Demand
Generation
Large Power Plant (RD&D) 1GW 15~30GW
FC CHP* 274k 1.4m 5.3m Replace Old Systems
*Primary energy: natural gas
Mobility
HRS 103 160 320 (900) Replace Filling Stations
FCV 3.0k 40k 200k 800k
FC Bus 18 100 1.2k
FC FL 160 500 10k
Replace Conventional Mobility
Industry Use (RD&D) Expand H_2 Use
Source: Ministry of Economy, Trade and Industry


29
Fuel Cell
Fuel Cell Stack
Key
Hydrogen
Proton (+ve)
Oxygen
Electron (-ve)
Anode
Cathode
Hydrogen
H2 Fuel
Oxygen
O2 From Air
HEAT
H2 Recycling
Air and
Water Vapour
Gas Diffusion Layer
Catalyst
Catalyst
Gas Diffusion Layer
Proton Exchange Membrane
100 µm
PGM-free catalyst layer
Nafion membrane
Pt catalyst layer
Microporous layer
Gas diffusion layer (GDL)
cross-section SEM image of
a PEMFC MEA
https://mechaniclove.com/hydrogen-fc/
https://en.wikipedia.org/wiki/Proton-exchange_membrane_fuel_cell


30
Catalyst for Fuel Cell
Silicone
plug
Glass
reactor
Metal
electrode
DMF
solution
Plasma
Stirrer
Frequency = 30 kHz
Voltage (kV)
Time (s)
Pulse width = 1.0 µs
Experimental set up of the SP process
Pt
Au
Plasma
PtPd-NFG
Shell
Core
5 nm
Mater. Adv., 2021, 2, 322-335

FIELD I

OPERATION RESEARCH

DETERMINATION OF FACTORS THAT AFFECTING THE INFANT MORTALITY RATE (IMR) IN EAST NUSA TENGGARA

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ABSTRACT

The Indonesian government always tries to make its people prosperous. The level of population welfare can be measured by nutritional status, mortality, and population morbidity. One of the public health status seen from population mortality is the Infant Mortality Rate (IMR) indicator. IMR is the number of infant deaths aged 0 to before one year out of 1000 live births. One of the regions in Indonesia that experienced IMR problems is the East Nusa Tenggara Province. The number of death cases continued to increase from 2016 to 2018. That is thought to be caused by various internal and external factors in the population. Analysis of the increase in the number of IMR can be identified by analysis using the nonparametric regression method because the relationship between the predictor variable and the response variable does not form a particular pattern. A nonparametric method used is the Multivariate Adaptive Regression Splines (MARS) because the predictor variables are high dimensions. The data processed is IMR data in East Nusa Tenggara Province in 2018 with district/city as research units and the factors that influence the occurrence of IMR. Based on the analysis, the highest IMR is owned by Sabu Raijua District, and the variables that have a significant effect on the MARS model are the percentage of births assisted by health workers (X_1) and the percentage of babies with low birth weight (LBW) (X_4).

Keywords : East Nusa Tenggara, Infant Mortality Rate (IMR), Multivariate Adaptive Regression Splines

1. INTRODUCTION

The health of Indonesian population is an important issue that receives special attention from the government. Because health is closely related to the survival of the population, the government can determine the population's health status through nutritional status, mortality, and population morbidity. One of the public health status seen from population mortality is the Infant Mortality Rate (IMR) indicator. IMR is a number that shows the number of deaths of infants aged 0 to before one year from every 1000 live births. IMR in an area is used to determine children's health status and the socio-economic conditions of the environment where residents live. In general, IMR is inversely correlated with the population's economic status, so that IMR can be used as an indicator to determine changes in population health conditions.

The Indonesian government has launched a National Medium-Term Development Plan (RPJMN) for 2015-2019 concerning the improvement of the Indonesian people's health and nutrition status, one of which is by reducing IMR. Besides, IMR was also discussed by UN member countries in September 2015 in a series of the 2030 Sustainable Development Agenda, which discusses reducing infant mortality by including it in the 17 Sustainable Development Goals (SDGs). The goal addressing infant mortality is the third goal, with one of the targets is to ensure a healthy life and support the welfare of all ages people so that all countries by 2030 targeted to end preventable deaths in infants and young children.

One of the provinces in Indonesia that has IMR problems is the East Nusa Tenggara Province, which the number of infant mortality cases from 2015-2018 had fluctuated, in 2014 there were 1280 cases (14 per 1000 live births), in 2015, it increased to 1488 cases (10 per 1000 live births), in 2016 it decreased to 704 cases (5 per 1000 live births), in

2017 it increased to 7 per 1000 live births, and in 2018 it increased to 1131 cases (11.7 per 1000 live births). Case of infant mortalities from 2016 to 2018 continued to increase. This case is very worrying considering IMR is an essential indicator in public health development. Therefore, it is necessary to know the factors that significantly influence the occurrence of IMR so that it can be used by the East Nusa Tenggara Provincial government for consideration to more focused on development planning, especially in reducing the number of IMR in East Nusa Tenggara Province.

Factors that expect to influence IMR can be analyzed using a parametric or nonparametric regression approach, it is seen from the data patterns formed between the predictor variables and the response variables. The parametric approach used for data forms a particular pattern, while the nonparametric approach when the data does not form a specific pattern. IMR data and the factors that expect to influence it do not form a specific pattern so that data processing uses a nonparametric approach. One of the nonparametric methods used is the Multivariate Adaptive Regression Splines (MARS). This method can be used because the number of predictor variables in high-dimensional research is $(3 \le v \le 20)$, v is the number of predictor variables.

Therefore, this study aims to determine the characteristics of IMR data and modeling in East Nusa Tenggara Province using a nonparametric Multivariate Adaptive Regression Splines (MARS) regression approach.

2. LITERATURE REVIEW

2.1. Descriptive Statistics

The statistical method discusses the procedures used in data collection, presentation, analysis, and interpretation. Statistical methods consist of two, they are descriptive statistics and inferential statistics. Descriptive statistics is a method related to collect and present data to provide information only about data and without conclusion Descriptive statistics used in this study are mean and variance.

2.2. Multivariate Adaptive Regression Splines

The most widely used statistical method to determine the relationship and effect between predictor variables and response variables is the regression method. The regression method consists of three approach models, they are parametric, semiparametric, and nonparametric. If the predictor variable and the response variable have a shaped pattern, it can be analyzed with a parametric approach model. In contrast, if the relationship between the predictor variable and the response variable does not form a particular pattern, it is analyzed using a nonparametric approach. One of the nonparametric approaches is the Multivariate Adaptive Regression Splines (MARS).

The MARS method is one of the nonparametric methods introduced by Friedman in 1991. The MARS model is used to estimate high-dimensional data problems, which is data with the number of independent variables produces accurate variable predictions and produces a continuous model in knots based on the smallest value of Generalized Cross-Validation (GCV). Besides, the MARS method can also be used in continuous and categorical responses. MARS with the continuous response is used if the response is quantitative type, which is interval or ratio data, while MARS with the categorical response is used if the response is qualitative type, which is nominal or ordinal data.

MARS merupakan kombinasi kompleks antara truncated splines dengan Recursive Partitioning Regression (RPR). Berdasarkan kombinasi tersebut menjadikan MARS memiliki kelebihan apabila dibandingkan dengan truncated splines dan Recursive Partitioning Regression (RPR). Berikut merupakan beberapa kelebihan metode MARS.

MARS is a complex combination of truncated splines with Recursive Partitioning Regression (RPR). Based on this combination, MARS has specialties other than truncated splines and Recursive Partitioning Regression (RPR). The following are some of the advantages of the MARS method.

a. Multivariate Adaptive Regression Spline (MARS) can accommodate additive effects and interaction effects between predictors in its modeling, while truncated spline only accommodates additive effects.

b. Multivariate Adaptive Regression Spline (MARS) can be used in regression modeling involving continuous and categorical responses, whereas truncated spline is generally only used for continuous responses.

c. Multivariate Adaptive Regression Spline (MARS) has advantages in computation time for data modeling that involves many predictors compared to the truncated spline. The selection of knots in MARS is made by adaptive procedures, which include forward and backward stepwise.

d. Multivariate Adaptive Regression Spline (MARS) compared to RPR, MARS produces a continuous model at knots, whereas in RPR, a continuous model at knots is not found.

There are some things that must be considered in modeling using the MARS method are as follows :

a. *Knot*

The knot is where the pattern or regression line changes. The minimum distance between knots or minimum observation between knots (MO) is determined by trial and error until the minimum GCV is obtained.

b. *Basis function* (BF)

The basis function is the interval between consecutive knots and explains the relationship between the response variable and the predictor variable. The number of basis functions is two to four times the number of predictor variables.

c. *Maximum interaction* (MI)

Maximum interaction (MI) is the maximum number of interactions between variables with values 1, 2, and 3.

d. *Minimum observation* (MO)

MO is the minimum distance between knots. The values are 0, 1, 2, and 3.

The MARS regression equation, which states the relationship between a predictor variable and a single response variable, can be written in equation 1 below.

$$\hat{f} = \alpha_0 + \sum_{m=1}^{M} \alpha_m \prod_{k=1}^{Km} \left[s_{km} \cdot \left(x_{v(k,m)} - t_{km} \right) \right]_+ \quad (1)$$

Where the function,

$$\left(x_{v(k,m)} - t_{km} \right)_+ = \begin{cases} \left(x_{v(k,m)} - t_{km} \right), x_{v(k,m)} - t_{km} > 0 \\ 0, x_{v(k,m)} - t_{km} \le 0 \end{cases} \quad (2)$$

where,

$\hat{f}$: estimation of MARS model

α_0 : the constant coefficient of the function B_0 basis

α_m : coefficient of the m function basis

$x_{v(k,m)}$: independent variable

t_{km} : knot value of the independent variable $x_{v(k,m)}$

M : the number of interactions in the m-th basis function

s_{km} : the value equal to 1 if data on the right side of knot point or -1 if data on the left side of knot point

v : the number of predictor variables

k : the number of interactions

The estimation of $\{\alpha_m\}_{m=0}^{M}$ is determined using the smallest square method (*ordinary least square or* OLS). If the form of a matrix can be written as,

$$\mathbf{y} = \mathbf{B}\boldsymbol{\alpha} + \boldsymbol{\varepsilon}$$

where,

$$\mathbf{y} = (y_1, ..., y_n)^T, \boldsymbol{\alpha} = (\alpha_0, ..., \alpha_M)^T, \boldsymbol{\varepsilon} = (\varepsilon_1, ..., \varepsilon_n)^T$$

$$\mathbf{B}=\begin{bmatrix} 1 & \prod_{k=1}^{K_1}\left(s_{k1}\left(x_{1v(k,1)}-t_{k1}\right)\right)_+ & \cdots & \prod_{k=1}^{K_m}\left(s_{kM}\left(x_{1v(k,M)}-t_{kM}\right)\right)_+ \\ 1 & \prod_{k=1}^{K_1}\left(s_{k1}\left(x_{2v(k,1)}-t_{k1}\right)\right)_+ & \cdots & \prod_{k=1}^{K_m}\left(s_{kM}\left(x_{2v(k,M)}-t_{kM}\right)\right)_+ \\ \vdots & \vdots & \ddots & \vdots \\ 1 & \prod_{k=1}^{K_1}\left(s_{k1}\left(x_{nv(k,1)}-t_{k1}\right)\right)_+ & \cdots & \prod_{k=1}^{K_m}\left(s_{kM}\left(x_{nv(k,M)}-t_{kM}\right)\right)_+ \end{bmatrix}$$

In the equation, $\mathbf{y}$ is a vector of the response variable with size of $(\mathrm{n}\times 1)$ and **B** is a function-based matrix of size $(\mathrm{n}\times(\mathrm{M}+1))$. Meanwhile $\boldsymbol{\alpha}$, the regression coefficient vector of size $((\mathrm{M}+1)\times 1)$ and $\boldsymbol{\varepsilon}$ is error vector of size $(\mathrm{n}\times 1)$.

The first MARS model's formation is to determine the points of change in the data behavior pattern or knot points. The selection of knots in MARS using forward stepwise and backward stepwise algorithms based on the smallest value of *Generalized Cross-Validation* (GCV) [5]. The forward stage is performed to obtain the number of basis functions by minimizing the *average sum of square residual* (ASR). The simple model concept can be fulfilled by the backward stage, which is by selecting the basis of the function generated from the forward stage by minimizing the value of *Generalized Cross-Validation* or GCV [7]. The best model in MARS modeling is obtained with a minimum GCV value. The minimum GCV form as a criterion for determining knots is written in the following equation.

$$GCV(M)=\frac{\frac{1}{n}\sum_{i=1}^{n}\left[y_i-\hat{f}_M(x_i)\right]^2}{\left[1-\frac{C(M)}{n}\right]^2} \qquad (3)$$

where,

y_i : response variable value

C : the estimated value of the response variable in the base function M

$C(M)$: *trace* $\left[\mathbf{B}\left(\mathbf{B}^T\mathbf{B}\right)^{-1}\mathbf{B}^T\right]+1$

$\mathbf{B}$: base matrix function

If MARS has the same minimum GCV value in determining the best model, then the minimum MSE value or the highest value can be used. Below is the formula R^2 used.

$$R^2=\frac{\sum_{i=1}^{n}\left(y_i-\hat{y}_i\right)^2}{\sum_{i=1}^{n}\left(y_i-\bar{y}_i\right)^2} \qquad (4)$$

The result of MARS model, the coefficient *basis function* (BF) is tested, including simultaneous tests and individual tests. Coefficient test is performed simultaneously on the essential function in the MARS model. The coefficient test aims to determine whether the selected MARS model is generally appropriate and shows the right relationship between the predictor variable and the response variable. The hypothesis used is as follows with M is the number of predictor variables.

$H_0:\alpha_1=\alpha_2=\alpha_3=...=\alpha_M=0$

$H_1:$ at leats one of $\alpha_j\neq 0,\ j=1,2,...,M$

The test statistics used is as follows

$$F_{value}=\frac{MSR}{MSE}=\frac{((SSR)/p)}{((SSE)/(N-p-1))} \qquad (5)$$

where,

$$SSE=\sum_{i=1}^{n}\left(y_i-\hat{y}_i\right)^2 \qquad (6)$$

$$SSR=\sum_{i=1}^{n}\left(\hat{y}_i-\bar{y}_i\right)^2 \qquad (7)$$

Reject H_0 if *Fvalue* more than *Ftable*, with degrees of freedom value $(df_1)=p$ and $(df_2)=N-p-1$, As a significance level value α, partial (individual) test is used to determine whether each predictor variable significantly affects the response variable based on the model's function and can describe the actual data. The hypothesis used is as follows: M is the number of predictor variables.

$H_0:\alpha_j=0$

$H_1:\alpha_j\neq 0,\ j=1,2,...,M$

The test statistics used is as follows.

$$t_{hitung} = \frac{\hat{\alpha}_j}{SE\left(\hat{\alpha}_j\right)} \quad (8)$$

Reject H_0 if $t_{value} > t_{\left(\frac{\alpha}{2};v_2\right)}$ or $t_{value} > -t_{\left(\frac{\alpha}{2};v_2\right)}$ with degrees of freedom $v_2 = N - k$ where k is the number of base functions that contribute to the model.

The MARS model has relative variable importance. The relative importance of the variable is each predictor variable's contribution that makes predictions of the response variable by considering the amount of contribution made when combined with other variables. The value of the predictor variable's importance shows the level of importance of the predictor variable on the grouping function, which is estimated by the increase of GCV value due to the transfer of the considered variables from the model [8]. The following is a formula of relative variable importance.

$$\text{Relative variable importance } = \frac{RSS}{N} \quad (9)$$

2.3. Infant Mortality Rate (IMR).

Infants are children aged 0 until before they reach 1 years old, while the infant mortality rate is a number that shows the number of deaths of infants aged 0 before reaching 1 years old out of every 1000 live births in a particular year in an area. The use of IMR is to reflect the state of health status in a community because newborn babies are susceptible to the conditions of the environment in which they live and the social status of their parents. If IMR decreases, it shows a high economic status in the area so that it can be used as an indicator to assess changes in the health condition of a community in a particular area [1].

The cause of infant deaths can be divided into two, they are direct cause and indirect cause. The direct cause of infant mortality are influenced by factors that the baby carries from birth and are directly related to the baby's health, including low birth weight (LBW), post-birth infections (tetanus, neonatorum, sepsis), hypothermia, and asphyxia. Meanwhile, infant mortality is not directly affected by environmental factors and maternal habits during pregnancy, such as socioeconomic factors, health services, maternal health during pregnancy, and the influence of the environment in which they live [9].

The variables that affect the survival of children are divided into two, as follows [10].

a. Variables that are considered exogenous or socioeconomic, such as economic, social, cultural, community, and regional factors. Infant mortality which is influenced indirectly by socioeconomic factors, is divided into five main factors:

1) Maternal factors: age, parity, and birth spacing
2) Environmental contamination: environmental pollution related to transmission to children (and mothers).
3) Nutritional deficiency: the survival of the child is not only affected by the availability of nutrition for the child but the mother as well
4) Accidents: accidents include physical accidents, for example, infanticide.
5) Individual disease control: one of the components in individual disease control is the preventive action done by healthy people to prevent disease.

b. Endogenous variables or biomedical factors which include breastfeeding patterns, hygiene, sanitation, and nutrition.

1) Individual level: household productivity, which includes education, health, and time, as well as traditions/attitudes in the environment
2) Household level: income/wealth

3) Regional level: ecological environment, political economy, and health system.

Child mortality, which includes infant mortality, is influenced by the demand side and the supply side. The demand side is household and individual behavior or characteristics such as sanitation, disease preventive action in the family, income, education, and parental knowledge. The supply side is government policies is implementation of policies, the capabilities of local governments, infrastructure and access, and also quality of health services [11].

3. RESEARCH METHODOLOGY

3.1. Data Source

The data was obtained from the East Nusa Tenggara Provincial Health Office's official report in East Nusa Tenggara Province Health Profile Book 2018 with 22 districts/cities as observation units in East Nusa Tenggara Province.

Var.	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Mean	89,9	61,8	69,8	10,8	94,5	96,27	76,24
Var.	68,03	582,16	597,14	309,9	473,63	619,95	135,21

Table 2. The mean and variance of the variables used

3.2. Research Variable

The research variables used in this study are as follows.

Table 1. Research Variable

Variable	Variable Description	Scale
Y	Infant Mortality Rate (IMR)	Ratio
X_1	The percentage of births assisted by health workers	Ratio
X_2	The Percentage of village/sub-district in *Universal Child Immunization* (UCI)	Ratio
X_3	The percentage of babies who are exclusively breastfed	Ratio
X_4	The Percentage of babies with low birth weight (BBLR)	Ratio
X_5	The percentage of babies getting vitamin A	Ratio
X_6	The percentage of pregnant women who received Fe_3 tablet	Ratio
X_7	The presentage of pregnant women implementing the K_4 program	Ratio

Based on the variables used in this study, the variables' operational definitions were obtained as follows.

a. Infant Mortality Rate

Infant Mortality Rate (IMR) is the number of infant deaths aged 0 years out of 1000 every live births in 2018 [1].

b. Percentage of births assisted by a health worker

The births assisted by a health worker is a birth or the process of giving birth to a baby assisted by a health worker with midwifery competence [12].

c. Percentage of village/sub-district in Universal Child Immunization (UCI)

Villages/sub-district Universal Child Immunization (UCI) is a village/sub-district in each district with complete immunization scope for a group of babies. UCI scope describes the level of community or infant immunity (herd immunity) to disease transmission that can be prevented by immunization [12].

d. Percentage of babies who are exclusively breastfed

Infants who are exclusively breastfed are boys and girls who receive breastmilk (ASI) directly during 0-6 months in East Nusa Tenggara Province [12].

e. Percentage of babies with low birth weight (LBW)

Low birth weight babies are babies who born with weight < 2500 grams. Birth weight is the baby's weight that is weighed within the first 1 (one) hour after birth.

f. Percentage of babies getting Vit A

Infants receive Vitamin A are infants aged 6-11 months who receive vit A capsules [12].

g. Percentage of pregnant women getting Fe_3 tablets

The percentage of pregnant women getting Fe_3 tablets are pregnant women who receive Fe_3 tablets to reduce anemia in pregnant women [12].

h. Percentage of pregnant women implementing the K_4 program.

The percentage of pregnant women implement the K_4 program for pregnant women who receive health services by professional health workers (obstetricians and midwives, general practitioners, midwives, and nurses) such as measuring body weight and blood pressure, examining uterine fundal height, immunization against *Tetanus Toxoid* (TT) as well as giving iron tablets to pregnant women during their pregnancy according to existing antenatal care guidelines with an emphasis on promotive and preventive activities [12].

3.3. Analysis Step

The analysis steps used in this research are as follows.

a. Collecting IMR data of East Nusa Tenggara Province in 2018 and the factors that are assumed to be influential.

b. Perform data preprocessing.

c. Perform descriptive statistical analysis of the response variables and predictor variables.

d. Identifying the form of data patterns between the response variables, which is IMR in East Nusa Tenggara Province, with each predictor variable.

e. Set a model for IMR data in East Nusa Tenggara Province using the MARS method in software R with the following steps [5].

f. Determine the combination of basis function (BF), maximum interaction (MI), and minimum observation (MO) as follows.

1) Determine the maximum BF that is 2 to 4 times the number of predictor variables used.

2) Determine the number of MI, which are 1, 2, and 3, with the assumption that $M > 3$ will produce an increasingly complex model.

3) Determine the number of MO between knots, which are 0, 1, 2, and 3.

g. Get the best model based on the minimum GCV value.

h. Estimating the MARS model parameters.

i. Perform the significance test of the MARS model parameters.

j. Draw conclusions and suggestions.

4. ANALYSIS RESULTS

4.1. Exploration of IMR and Factors Assumed of Affecting IMR in NTT Province

Data exploration aims to see the data's characteristics or to get an overview as initial information from data before determining or applying the appropriate analysis method. Infant Mortality Rate (IMR) reflects the state of health status in society because newborn babies are susceptible to the conditions of the environment in which they live and their parents' social status. The following are the characteristics of the factors that are thought to influence IMR in East Nusa Tenggara, in 2018, shown in Table 2, Based on Table 2, it can be seen that the highest mean percentage of pregnant women who get Fe_3 (X_6) tablets is 96.27%, or it can be concluded that on average pregnant women who get Fe_3 tablets from the government during pregnancy in the districts/cities in East Nusa Tenggara Province is 96.27%. In contrast, the variable percentage of babies with low birth weight (LBW) (X_4) in East Nusa Tenggara Province has the lowest mean, which is at 10.78% compared to other variables, this number means that the total number of babies present in East Nusa Tenggara Province in 2018, on average, each district/city had babies with low birth weight at 10.78%, so that the higher the LBW indicates that the worse the health conditions of babies in the region.

The variance of percentage pregnant women variable variance who receive the highest Fe3 (X_6) tablet, which is at 619.95, shows that the data in this variable varies between districts/cities in East Nusa Tenggara Province. The lowest variance value is owned by the variable percentage of births assisted by health workers (X_1), which is at 68,03, or it can be concluded that the data on the percentage of births assisted by health workers in East Nusa Tenggara Province in 2018 is not diverse enough. After knowing the data characteristics of the factors that influence IMR, then analyze the characteristics of IMR in East Nusa Tenggara Province

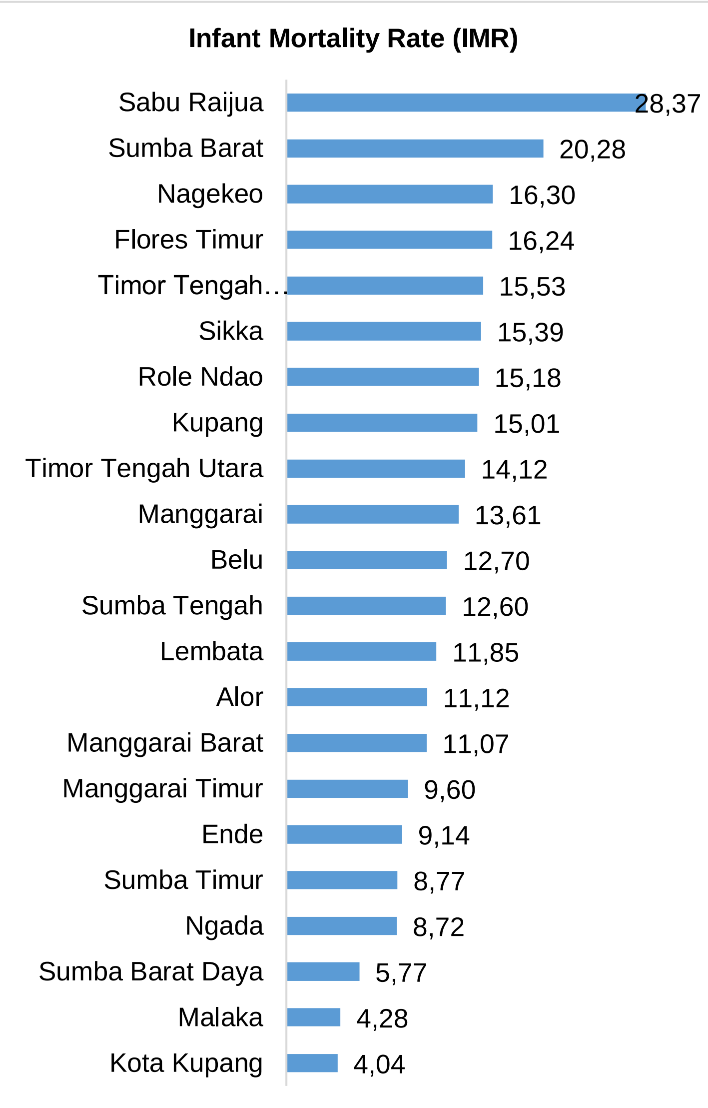

Figure 1. IMR Chart in East Nusa Tenggara Province 2018 by District/City

Figure 1 shows that Sabu Raijua District has the highest IMR. Several factors are thought to cause the high IMR in Sabu Raijua District. The percentage of births assisted by health workers in East Nusa Tenggara Province in 2018 is still relatively low compared to other districts/cities, which is occupy the second-lowest with a percentage of 74.9%. Also, compared to the overall average of births assisted by health workers in districts/cities in East Nusa Tenggara Province, the percentage of Sabu Raijua District is still lower.

Sabu Raijua District is also in the second-lowest percentage of UCI village/sub-district, which shows that there are still many villages/wards in the area that have not provided complete necessary immunization to infants so that it can be the cause of the high IMR. Besides that, the percentage of UCI village is also far below the average of overall percentage UCI villages/wards in East Nusa Tenggara Province. The UCI villages that are owned by Sabu Raijua District is 34.9%.

The percentage of exclusively breastfed babies is also very low, ranking second to last and very few compared to the overall average in East Nusa Tenggara Province, which is only 20.5%. Breast milk is essential for babies, so it is recommended to be given exclusively. If the percentage is very low, it can lead to death in infants due to lack of nutritious intake.

Furthermore, the percentage of low birth weight (LBW) in the Sabu Raijua District is still high which is at 7.8% of all babies weighted. The percentage of pregnant women who received 90 tablets of Fe3 tablets is still relatively low, which is at 70.1%, and is in the bottom three positions. Compared to other districts/cities, this number can also be low because it is below the average percentage of all pregnant women who receive Fe3 tablets in East Nusa Tenggara Province.

The last variable that is likely to cause a high IMR in Sabu Raijua District is the percentage of pregnant women who implement the K_4 program is still very low or the number of pregnant women who have checked themselves with health workers since the first trimester (early pregnancy) and still very minimal so that the health of the fetus is not monitored from the beginning of pregnancy. Compared with the average percentage of pregnant women who implement the K_4 program in all districts/cities in East Nusa Tenggara Province, the figure of 57% owned by Sabu Raijua is still quite far.

4.2. The formation of MARS Model

The initial step for the formation of the MARS model is to determine the combination of basis functions (BF) number, maximum interaction (MI), and minimum observation (MO) between knots. The basis function is the interval between consecutive knots and explains the relationship between the response variable and the predictor variable. The number of basis functions used is two to four times the predictor variable. Maximum interaction (MI) is the maximum number of correlation relationships between variables in the model. If the MI used is 1, then there is no interaction between variables in the model. If MI is 2, then there is an interaction of 2 variables in the model, and if MI is 3, then the model will have an interaction between 3 variables. Minimum observation (MO) is the minimum number of observations between knots, MO that can be used are 0, 1, 2, and 3.

The number of predictor variables used is 7, so the number of BF used is 14, 21, and 28. The maximum interaction (MI) used are 1, 2, and 3, while the minimum observation (MO) is 0, 1, 2, and 3. The combinations obtained from BF, MI, and MO are 36 models as in Table 4 below.

Based on Table 4, there are 36 models formed from a combination of BF, MI, and MO values. The best model is the one with the smallest GCV value. If the GCV value is the same, then it is considered with the highest R^2 value, and if the R^2 value is still the same, then it can adhere to the parsimony principle of the model, which is to consider the model that has the smallest combination of BF, MI, and MO.

Table 4. Modeling Result

No	BF	MI	MO	GCV	R^2
1	14	1	0	26,7	0,426
2	14	1	1	27,3	0,415
3	**14**	**1**	**2**	**22,5**	**0,517**
4	14	1	3	24,3	0,478
5	14	2	0	23,4	0,683
6	14	2	1	30,5	0,000
7	14	2	2	24,3	0,671
8	14	2	3	26,7	0,760
9	14	3	0	23,4	0,683
10	14	3	1	30,5	0,000
11	14	3	2	24,3	0,671
12	14	3	3	26,7	0,760
13	21	1	0	26,7	0,426
14	21	1	1	27,3	0,415
15	21	1	2	22,5	0,517
16	21	1	3	24,3	0,478
17	21	2	0	23,4	0,683
18	21	2	1	30,5	0,000
19	21	2	2	24,3	0,671
20	21	2	3	26,7	0,760
21	21	3	0	23,4	0,683
22	21	3	1	30,5	0,000
23	21	3	2	24,3	0,671
24	21	3	3	26,7	0,760
25	28	1	0	26,7	0,426
26	28	1	1	27,3	0,415
27	28	1	2	22,5	0,517
28	28	1	3	24,3	0,478
29	28	2	0	23,4	0,683
30	28	2	1	30,5	0,000
31	28	2	2	24,3	0,671
33	28	3	0	26,7	0,683
34	28	3	1	23,4	0,000
35	28	3	2	30,5	0,671
36	28	3	3	24,3	0,760

The model chosen is model number 3 with the combination of BF = 14, MI = 1, and MO = 2 because it has the GCV, R^2 value, and the smallest combination of BF, MI, and MO. The model's GCV value is 22,5, and the value is 0,517 so that the MARS model can be written as follows.

$$\hat{f}(x) = 21,660 - 0,418 * BF_1 - 1,633 * BF_2 \qquad (11)$$

Where basis function:

$BF_1 = h(X_1 - 75,7)$

$BF_2 = h(8,6 - X_4)$

In equation 11, it can be seen that the basis function interpretation is as follows.

a. $$BF_1 = h(X_1 - 75,7) = \begin{cases} 0, X_1 \le 75,7 \\ (X_1 - 75,7), X_1 > 75,7 \end{cases}$$

The coefficient $BF_1 = -0,418$ in model means that every one unit BF_1 increase will decrease the IMR by 0.418 with basis functions being considered constant. If the percentage of births assisted by health workers (X_1) is more than 75.7%, the IMR will decrease by 0.418.

b. $$BF_2 = h(8,6 - X_4) = \begin{cases} 0, X_4 \ge 8,6 \\ (8,6 - X_4), X_4 < 8,6 \end{cases}$$

The coefficient $BF_2 = -1,633$ in model means that every increase of one unit BF_2 will decrease the IMR by 1.633 with basis functions considered constant. If the percentage of babies born with low birth weight (LBW) (X_4) is less than 8.6%, it will reduce infant deaths by 1.633.

In equation 11, it can be seen that there are two predictor variables included in the MARS model, they are the variable of births assisted by health workers (X_1) and the variable percentage of low birth weight (LBW) (X_4). Furthermore, coefficient test is performed to determine that the selected MARS model is appropriate and shows the relationship between the predictor variable and the response variable. The following is a hypothesis used for simultaneous test.

$H_0 : \alpha_1 = \alpha_2 = \alpha_3 = ... = \alpha_M = 0$

$H_1 :$ at least one of $\alpha_j \ne 0, j = 1, 2, ..., M$

where rejection area: Reject *H0* if $F_{value} > F_{table}$

Table 5. Simultaneous Statistics Test

F_{value}	$F_{(0,05;7;14)}$	**P-*value***	**Decision**
10,16	3,5219	0,0009963	Tolak H_0

Based on Table 5, it can be seen that the decision to reject H_0 because the F_{value} is more significant than F_{table} and the *p-value* is less than the value $\alpha(0,05)$, this means that there is at least one significant α_j, which means that all BF simultaneously have a significant effect on the model or the response variable.

Furthermore, partially test is perfomed to determine whether each BF has a significant effect. The following is a partial test hypothesis.

$H_0 : \alpha_j = 0$

$H_1 : \alpha_j \ne 0, j = 1, 2, ..., M$

where rejection area: Reject *H0* if $|T_{value}| > T_{table}$

Table 6. Partial Statistics Test

Parameter	**Estimation**	***Std Error***	T_{value}
α_1	-0,4180	0,1272	-3,287
α_2	-1,6325	0,4344	-3,758

The value of T_{table} with $\alpha = 0,05$ and df = 20 is 2,086 so that all parameter values in Table 6 are obtained by the decision to reject H_0, which means that each predictor variable of basis function (X_1 dan X_4) contained in the model has a significant effect on the response variable.

The importance level of each predictor variable used in the study can be seen in Table 7 below.

Based on Table 7, it is known that the variable percentage of babies with low birth weight

(LBW) (X_4) has the highest contribution to the MARS model, which is 100%.

Table 7. The Importance level of Predictor Variable in MARS Model

Variable	Importance Level
X_4	100%
X_1	84,7%

Table 6. Partial Statistics Test

Variable	Importance Level
X_2	0
X_3	0
X_5	0
X_6	0
X_7	0

The variable that has the second contribution is the variable percentage of births assisted by health workers (X_1) at 84,7%, while the other five variables do not have a level of importance in the MARS model because the two variables represent them are in the model.

5. CONCLUSION AND SUGGESTION

Based on the results of the analysis, it is found that the predictor variable that has the highest mean and variance is the variable percentage of pregnant women who received Fe_3 tablets, which is at 96,27%, and the variance is 619,95. The region with the highest IMR is Sabu Raijua District at 28,369, and the lowest is Kupang City. The best model obtained is from the combination of BF=14, MI=1, and MO=2 so that the MARS model is $\hat{f}(x) = 21,602 - 0,418 * BF_1 - 1,633 * BF_2$ and the predictor variable that has the highest contribution is the variable percentage of babies with low birth weight (LBW) (X_4) at 100%, the second-highest contribution is the variable percentage of births assisted by health workers (X_1) at 84,7%.

While the suggestion for further research is that it is better to compare R software processing with MARS software results, and the government can consider the factors that have a significant effect in determining policy in suppressing IMR.

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ANALYSIS STUDY OF COASTAL RECLAMATION IMPACT TO THE NATIONAL RESILIENCE (A LITERALY, PHILOSOPHICAL, JURIDICAL AND SOCIOLOGICAL APPROACH)

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ABSTRACT

This study aims to analyze systemically and thoroughly the impact of coastal reclamation on National Resilience. Activities start from a comprehensive understanding of the system that occurs in the reclamation process and variables that affect national resilience. Meanwhile, based on observations and critical studies of previous research, the aspects that were considered significant were environmental, economic and socio-cultural aspects. Identification of aspects in detail is needed to obtain variables and criteria that have a significant effect on National Resilience. It can be explained that there is a close systemic relationship between factors and influential aspects where one aspect forms a causal relationship into a comprehensive system. These factors include, (1) Environmental Aspects, namely: Spatial Planning, Land Environment Sustainability, Water Environment Sustainability, Air Environment Sustainability, Coastal and Coastal Environmental Sustainability, Environmental Impact Analysis on National Resilience, (2) Economic Aspects , namely Community Income, Livelihood Security, Residential Sustainability, Community Survival and (3) Socio-Cultural Aspects, namely Customs / Laws, Community Life, Local Wisdom, Local Culture and Relations Between Public and Private Communities. Each aspect is analyzed its role in the National Resilience system as a result of Reclamation. The concept of system unity and variable idiosyncrasies is highlighted. In the final section, an analysis of physiological, juridical and sociological approaches is carried out to strengthen the research results.

Keywords: Analysis Study, Coastal Reclamation, National Resilience

1. INTRODUCTION

Coastal reclamation projects are not always as successful as expected. Based on the data, the North Coast Jakarta reclamation project is still in conflict and controversy between the community and the Jakarta Provincial Government. Likewise with the Benoa Bay Bali reclamation project, which is currently still holding controversy and prolonged conflict. This occurred because of the conflict between the will of the local community supported by the local Provincial Government and the desire of the Central Government to continue to develop and develop the Benoa Bay area into a tourist area, complete with various modern facilities and infrastructure. Even though it has received a lot of resistance from various elements of society and is starting to get strong support from the Bali Provincial Government, the reclamation project will continue considering Presidential Regulation No. 51 of 2014 concerning Amendments to Presidential Regulation No. 45 of 2011 concerning Denpasar Urban Spatial Planning, Badung. , Gianyar and Tabanan, are still valid and have not been revoked.

The next problem is that the Center Point of Indonesia (CPI) Reclamation Project in the Losari Beach area of Makassar, South Sulawesi (Sulsel) is still receiving criticism from various parties. This is because this project has caused severe damage to the coast and at the same time worsened the living conditions of coastal communities. The Indonesian Forum for the Environment, South Sulawesi Province, is one of the many parties who have often criticized the megaproject development. Walhi assessed that a lot of damage has been caused. According to the Director of Walhi Sulsel, one of the impacts caused by the CPI reclamation project is the occurrence of severe abrasion on Galesong Beach, Takalar Regency due to sea sand mining activities. Sand from the area is used in the reclamation project. The Losari reclamation location is contained in the Makassar City Spatial Plan 2005-2015 document. The reclamation plan area is divided into several zones, which contain allotment types, namely parking areas, pedicab-bicycle streets, pedicab bases, fast lanes, slow lanes, children's playgrounds, eating places, parks/boulevards, plazas, docks, motorized vehicle lanes. , garden, and pedestrian floors. (IDN Times Sulsel, 06 March 2020).

National Resilience Indonesia is the dynamic condition of the Indonesian nation which includes all aspects of integrated national life, contains tenacity and resilience that contains the ability to develop national strength, in facing and overcoming all challenges, threats, obstacles, and disturbances both coming from outside and from in, to guarantee the identity, integrity, survival of the nation and state and the struggle to achieve its national goals, (RI Defense White Paper, 2015). In regulating and carrying out their life, the Indonesian nation cannot be separated from the influence of interactions with its environment, both in the national, regional, and global scope in maintaining and increasing the value of its National Resilience. Predictions in the form of perceptions that develop in the community about the impact of reclamation on National Resilience on the Socio-Cultural, Economic, and Environmental aspects are a reflection of hypotheses that must be verified, so more in-depth research is needed to assess whether there is an impact on Reclamation development. Coast to National Resilience in these aspects.

This research discusses scientifically and in more detail the analysis of the systemic impact of coastal reclamation studies on National Resilience, especially on the significant aspects that influence it, based on literature studies and current issues that are currently developing, namely on the socio-cultural, economic, and environmental aspects. These three aspects are currently a current issue and are hotly discussed by many groups, both the general public and academics, and based on literature studies on previous research.

Coastal reclamation projects, in particular, can affect National Resilience in the socio-cultural, economic, and environmental aspects. Each of these aspects in the national life system relatively changes according to time, space, and environment, these aspects change dynamically so that their interactions create general conditions that are very difficult to monitor because they are very complex. Physiological, Juridical, and Sociological Approaches are a combination of theory, method, and philosophy to analyze behavior in a system in society (Yang Song, 2015). This approach builds in general from symptom identification to producing problem structures for simulation evaluation/policy analysis in making decisions, both for evaluating strategic steps that have been taken in producing system performance, as well as for evaluation/analysis in achieving desired goals. Physiological, juridical, and sociological approaches are comprehensive policy evaluation models that view every problem holistically, systematically, and integratively. By using physiological, juridical, and sociological approaches, it is hoped that the process and results of problem-solving in the form of policy scenarios can be implemented effectively and efficiently (Forrester, 1995).

Based on the existing background, the objectives of this study are as follows:

a. Obtain critical studies and literacy studies related to the impact of coastal reclamation on National Resilience

b. Obtain what factors affect the socio-cultural, economic, and environmental aspects of national resilience as a result of coastal reclamation.

c. Obtain an analysis of the philosophical, juridical, and sociological approaches of the policy on the impact of Coastal Reclamation on the value of National Resilience.

The focus of this research is limited to the following matters:

a. The focus of research is on the socio-cultural, economic, and environmental aspects that have a very significant effect on coastal reclamation which has an impact on national resilience. This has been based on preliminary field studies and literature studies on previous scientific research, which proves that these aspects significantly affect National Resilience for specifically Coastal Reclamation project activities, in addition to aspects of ideology, politics and defense and security which are not included in the research. this is in the context of Coastal Reclamation.

b. The research study is focused on the Coastal Reclamation project area which can represent the condition of National Resilience in the socio-cultural, economic, and environmental aspects with a physiological, juridical, and sociological approach.

2. MATERIALS DAN METHODS

2.1. Coastal Reclamation

According to its linguistic understanding, reclamation comes from English, to reclaim which means repairing something that is damaged. The English-Indonesian Dictionary specifically states the meaning of reclaim as to make land (from the sea). Still in the same dictionary, the meaning of the word reclamation is translated as the work of acquiring land. Not many experts have defined or provided an understanding of coastal reclamation.Coastal reclamation activities are technological efforts made by humans to transform a natural environment into an artificial environment, a typology of estuary, mangrove and coral reef ecosystems into a land landscape. Reclamation is an activity carried out by people in order to increase the benefits of land resources from an environmental and socio-economic point of view by filling, draining the land or drainage (Yustiana et al, 2021).

Another definition of reclamation is an occupation / effort to utilize an area or land that is relatively useless or is still empty and watery to become useful land by drying it. For example in coastal areas, swamp areas, offshore / in the sea, in the middle of a wide river, or in a lake. Basically, reclamation is an activity to change coastal waters to land. Reclamation is intended to be an effort to change the low land surface (usually affected by standing water) to be higher (usually not affected by standing water). By definition, the main purpose of reclamation is to make water areas that are damaged or useless better and more useful. These new areas are usually used for residential, industrial, business and shopping areas, agriculture, and tourist attractions. In urban planning, coastal reclamation is one step of urban expansion. Reclamation is practiced by countries or large cities whose growth rates and land needs are increasing rapidly but experiencing obstacles due to the narrowing of land (limited land). Under these conditions, it is no longer possible to expand the city to the mainland, so that a new land is needed. The method of reclamation provides benefits and can help the state / city in the context of providing land for various purposes (urban expansion), structuring coastal areas, developing marine tourism, and others.

2.1. Policy Theory and Concepts

The policy is defined as a strategic direction approved by the government to overcome an identified problem (Government, 2010). According to Juma and Onkware, policies can be defined in various forms. There are several opinions which state that policy is the output of a political system. Whereas at a lower level, the policy is an activity that is related to several different activities (Juma & Onkware, 2015).

The policy is a means of action from the government to dilute or promote certain phenomena that occur in the community. A policy can outline a rule, provide principles that guide action, implement roles and responsibilities, reflect the values and principles, and intentions of a country. Policies can be enforced by all levels of government (federal, provincial, regional and municipal), communities, organizations, businesses, and schools (Steinberg, Jacobson, & Powadiuk, 2015).

Etymologically, the term policy comes from the English word "policy", however, most people are of the view that the term policy is always equated with the term policy. When examined based on grammar, the term wisdom comes from the word "wisdom". The term policy itself is still subject to disagreement and is an arena for expert debate. Theory of policy is defined in one of three policy definitions (Imurana, 2014), including:

a. Policy is a very different set of activities.
b. Policy is a disjointed process, not a continuous process.
c. Policy is a phenomenon that occurs in a short time and quickly in the actual period.

2.2. Conception and Essence of National Resilience

National Resilience Indonesia is the dynamic condition of the Indonesian nation which includes all aspects of integrated national life, contains tenacity and resilience that contains the ability to develop national strength, in facing and overcoming all challenges, threats, obstacles, and disturbances both coming from outside and from in, to guarantee the identity, integrity, survival of the nation and state and the struggle to achieve its national goals, (RI Defense White Paper, 2015).

The Indonesian National Resilience Concept (Tannas) is the conception of National Resilience or the development of national strength through the regulation and implementation of balanced, harmonious, and harmonious welfare and security in all aspects of life as a whole and integrated based on Pancasila, the 1945 Constitution, and the Archipelago's Insight. The conception of Indonesian National Resilience is a guideline (means) to increase (method) the resilience of the nation which contains the ability to develop national strength, with a welfare and security approach. The condition of national life is a reflection of national resilience based on the ideal foundation of Pancasila, the constitutional foundation of the 1945 Constitution, and the conceptual foundation of the Archipelago Concept.

The essence of Indonesia's national resilience is the tenacity and resilience of the nation which contains the ability to develop national strength, to be able to guarantee the survival of the nation and state in achieving national goals. Meanwhile, the essence of the conception of Indonesia's national resilience is the regulation and implementation of welfare and security in a balanced, harmonious, and harmonious manner in all aspects of national life (RI Defense White Paper, 2015).

2.3. Dimensions of National Resilience Assessment

The Indonesian people are grateful for all of God's gifts, both in the form of a constellation and geographic position, as well as all the contents and potential of the archipelago to be utilized as much as possible for the improvement of the degree, dignity of the nation and the state of Indonesia in the association between nations. In utilizing the content and potential of natural resources, it is necessary to have the quality of Indonesian people. Especially facing a population that continues to increase, while the earth / nature that provides all human needs can be said to be relatively fixed or not increasing. In other words, humans as objects who continue to want the fulfillment of needs extracted from natural resources, and are highly dependent on geographic conditions, are three natural elements / aspects that cannot be separated from one another and are interrelated.

Every aspect in the national life order relatively changes according to time, space and environment, especially in dynamic aspects so that their interactions create general conditions that are very difficult to monitor, because they are very complex. In the context of understanding and fostering the order of national life, a certain simplification of various aspects of national life is needed in the form of a model which is the result of a mapping of the real situation, through an agreement from the results of in-depth analysis based on the theory of the relationship between humans and God, humans and humans / society. and between humans and the environment. In the simplification process, the number of aspects of national life is reduced to a minimum, but still can present the main characteristics of phenomena and problems, which are called Gatra, (RI Defense White Paper, 2015).

Based on the understanding of the relationship between humans and their natural surroundings, mapping is obtained in 3 relatively static dimensions (Trigatra), namely geographic dimensions, natural resources and population, while based on the understanding of human relations in social life, it is agreed that in the conception of Indonesian National Resilience all aspects of life national is mapped into 5 social dimensions (Pancagatra) which are dynamic and considered dominant, namely the ideological, political, economic, socio-cultural, defense and security dimensions. The 3 natural dimensions (Trigatra) when combined with the 5 social dimensions (Pancagatra) will become 8 dimensions (Astagatra) which are a comprehensive mapping model of the national life system of the Indonesian nation. The 8 gatra (Astagatra) are a whole and integrated together to form the code of conduct for the people of the nation and state.

3. RESULT AND DISCUSSION

3.1. Critical Study of Previous Research

Critical reviews or critical studies of previous research must be carried out to find out what is a gap, gap, or difference in a study. This section is the part that gets attention and must be done in a focused and deep way. This is done to determine which parts have been worked on by other researchers, and which parts can still be developed, or perhaps to determine new things. The following are the results of a critical review of several journals and previous research:

a. **Asri Setianingrum Kenyo Handadari**, Tri Edhi Budhi Soesilo, Widodo Setiyo Pranowo (2018), in research on the Index of Sustainability of Marine and Coastal Resources at the Benoa Bay Bali Reclamation Site. The issue raised was that Reclamation has become a hot and sensitive topic in Indonesia in the past 5 years. The argument has developed considering the conflicting needs of space for macroeconomic interests, while in the desired location there have been many previous microeconomic and social community activities. The government as the regulator regulates reclamation activities in coastal areas and small islands through Presidential Regulation 122/2012. In the regulatory norm, reclamation is an effort to restore or increase the benefits of land resources that no longer have economic and ecological value, the implementation of which does not cause social conflict. Reclamation should aim to increase the benefits of land resources for the benefit of the community. This research aims to determine the sustainability of marine and coastal resources in Benoa Bay when reclamation is carried out. Sustainability assessment is based on 4 dimensions: environmental, social, economic, and utilization of marine space. The index is compiled using a quantitative approach with the Multi-dimensional Scaling (MDS) method, with the Monte Carlo significance test, and the sensitivity test for each dimension attribute. The results of the multi-dimensional analysis show that the reclamation of Benoa Bay is not / less sustainable (43.15%). When examined the index of each dimension, the: utilization of marine space (27.05%), economy (44.313%), social (49.79%), environment (49.88%). The utilization of marine space in Benoa Bay requires further government policy intervention to avoid social conflict with the community by enforcing marine spatial planning regulations. However, this study does not discuss the relationship between variables: (a) Environmental, Social, (b) Economic, and (c) Utilization of marine space as a system that interacts with one another. As a critical study, what needs to be developed in this study is the management of variables that influence the reclamation problem to be processed simultaneously as an interacting system.

b. **Ulung J. Wishaa**, Try Altanto, Widodo S. Pranowo, Semeidi Husrin (2017), in his research on Current Movement In Benoa Bay Water, Bali, Indonesia: Pattern Of Tidal Current Changes Simulated For The Condition Before, During, And After Reclamation. Benoa Bay is an intertidal reclamation area that has become an important area. Many problems arise because reclamation decreases the welfare of residents (due to disruption of fishing activities), social and cultural problems, and environmental degradation. This study aims to determine the hydrodynamic changes that have occurred due to regional development. This study uses a numerical method (flow model) which is based on heavier questions. In the 1995 simulation, the flow velocity ranged from 0-1.4 ms - 1. In the 2016 simulation, the flow rate was between 0-1.35 ms - 1.When reclamation was carried out, the flow rate changed between 0-1.2 ms - 1. It is known that during low tide conditions, some areas within the bay are not covered by water due to high levels of sedimentation and unstable sediment distribution caused by the development of Benoa Bay. It is clear why the area inside the bay will be reclaimed. Based on the simulation, the condition will get worse. The degradation of Benoa Bay resulted in changes in hydrodynamic patterns which adversely affect the circulation and the resulting biology. The water flow is cut off will automatically mess up the mass transportation mechanism of the water, and if it is in progress, will hamper it. However, this study does not discuss the weighting element between variables, and it has not shown a relationship or correlation between variables as an interacting system. All variables were assessed for their influence but their nature was still partial. As a critical study, this research can be further developed by including the weight element and the interaction relationship between variables in the coastal reclamation process as a system.

c. Arya Pageh Wibawa (2017), in his research on "Symbolic Battle in Benoa Bay Reclamation Bali Indonesia", in the International Journal of Science and Research (IJSR), suggests that Bali is a very famous tourist destination in the world. With the reclamation which relies on Presidential Decree No. 51/2014 concerning spatial planning for the cities of Denpasar, Badung, Gianyar, and Tabanan, the Government will revitalize Benoa Bay related to its spatial use. The reclamation plan raises pros and cons. This study aims to describe the forms, strategies, and factors that cause conflict in Balinese society due to the Benoa Bay Reclamation. The method used in this research is descriptive qualitative. This study aims to provide an overview of the conflicts that occur in the reclamation of Bali Benoa Bay based on observations in print or online media. The conclusion of this study shows that the conflict that occurred due to the reclamation plan of Benoa Bay was carried out by a dominant group (orthodox) using a form of recognition of a certain meaning, logic, perspective, and value, namely Presidential Role No. 51 of 2014. Meanwhile, the opponent (heterodox) denied by giving rules unknown to the dominant group (orthodox) and took mass action against the dominant group. The strategy adopted by the dominant group (orthodox) in this symbolic battle is euphemization and censorship by giving benefits of reclamation as reasons such as tourism accommodation and additional employment opportunities. Whereas previously the orthodox group issued a circular requesting the temporary suspension of the construction of tourism accommodation for the South Bali region, namely Gianyar Regency, Badung, and Denpasar City due to "overcapacity". Therefore, the commitment of the orthodox group in the reclamation of Benoa Bay needs to be questioned again. The factors that led to the symbolic battle were the differences in interests between orthodox and heterodoxic groups. The dominant group (orthodox) considers it important for reclamation because there are social and economic values that can improve the lives of Balinese people. Meanwhile, according to opponents (heterodox) the reclamation could disrupt social and cultural life, namely Tri Hita Karana, which could be a disaster for the Balinese people as a result of disturbances in the balance and harmony of the surrounding nature. However, this research only focuses on the discussion of reclamation in a qualitative model. The factors and variables used are quite brief, only covering: symbolic battle data, the potential for maritime, and fisheries from online and print media. As a critical study, this research needs to have collaborated with more complex methods and variables that can be applied in the context of systemic reclamation impact analysis.

d. I Putu Gede Ardhana, Mutria Farhaeni (2017), in a study entitled The Study of the Impact for Social Culture toward the Planning of Reclamation for Benoa Bay in Bali. This research raises the issue of how the impact of the reclamation plan on the socio-cultural conditions of the local community. The results show that a policy is needed that provides effective management and protection of local community resources, maritime culture, national resilience, especially a structured government, following the principles of sustainable ecosystem-based reclamation area management. As a critical study, this study has not discussed policies or regulations that deal with the protection of coastal natural resources as the impact of coastal reclamation impacts on National Resilience. So it is necessary to collaborate with methods and variables of Environment, Economy, and Socio-Culture which are more complex and can be applied in the context of a sustainable National Defense which is the impact of the implementation of Coastal Reclamation.

e. **Bradley W. Barr** (2013), in a study entitled Understanding and Managing Marine Protected Areas through Integrating Ecosystem-Based Management within Maritime Cultural Landscapes, suggests that the integration of ecosystem-based management and coastal reclamation views on the environment and socio-culture towards national resilience changes from time to time dynamically based on the EBM model (Ecosystem-Based Management) and MCL (Maritime Cultural Landscapes). As a critical study, this research has not yet discussed cultural adaptation and national resilience to various zones, as a systemic impact of coastal reclamation. What needs to be developed is those cultural variables and national resilience that affect the reclamation process are processed simultaneously as an interacting system to be analyzed in-depth and holistically.

f. **Adharani Y**, Nurlinda I, Nadia A, Yusuf S Z, dan S Sarah A (2019), in his research entitled Jakarta Bay Reclamation: The Challenge Between Policy, Environmental and Social Impacts'. The problem that can be raised in this research is the lack of compatibility between environmental, social, economic and policy aspects in the management of coastal areas to the reclamation of Jakarta Bay. The results of this study are in the form of policy changes related to coastal management through reclamation in Jakarta Bay so that it requires re-planning of the North Coast Jakarta Reclamation area. The management plan for the Jakarta Bay reclamation area should be integrated based on an interdisciplinary approach involving related parties. Integrated Coastal Management (ICM) science is the right instrument to do in the management of the Jakarta Bay coast. As a critical study, this research has not included the national resilience factor, so this research can be further developed by incorporating elements of National Resilience as a system dynamic between variables. As well as the interaction relationship between variables in the coastal reclamation process as a system that is assessed for its role in Indonesia's National Resilience.

Based on the critical reviews or critical studies that have been carried out in previous research, it can be said that the aspects of the discussion of coastal reclamation, environmental, socio-cultural, economic, and sustainability modeling as well as partial aspects of National Resilience have been discussed in previous studies. These aspects are still being done partially or separately between variables, there is no interaction between variables, so as a critical study there is a gap that can be developed and become a GAP for this Dissertation research, namely how to analyze the interaction model and systemic relationships

Environmental, Economic and Socio-Cultural variables as a system that interacts with Government Policy in a comprehensive National Resilience Assessment.

Based on the critical study in this previous research, then the identification of the factors that influence this study is compiled.

3.2. Identification of Influencing Factors

The identification of aspect variables and initial criteria compiled is the result of a literature study on international and national journal papers relating to coastal reclamation and national resilience, as well as brainstorming and discussions with experts in the field of coastal reclamation and National Resilience, (Yustiana et al, 2021).

The Interaction Relationship of factors influencing Coastal Reclamation on National Resilience, on environmental, economic, and socio-cultural aspects forms the interaction relationship as a holistic system. These things underlie the arrangement of the variable aspects and components that affect the coastal reclamation system. In the end, we found 3 (three) main factors and sub-component aspects that affect coastal reclamation, which affect the National Resilience Value. (Yustiana et al, 2021).

Furthermore, the three main factors mentioned above along with the sub-aspects of the criteria or components that influence them are compiled in the form of a coastal reclamation system conceptualization that affects the National Resilience Value according to the causal diagram as in Figure 1.

In Figure 1, it can be explained that there is a close systemic relationship between factors and influential aspects where aspects from one another form a causal relationship into a comprehensive system. The factors, among others, are as follows:

a. Environmental Aspects, namely:
   1) Regional Layout
   2) Land Environment Sustainability
   3) Water Environment Sustainability
   4) Air Environment Sustainability
   5) Coastal and Coastal Environmental Sustainability
   6) Environmental Impact Analysis on National Resilience

b. Economic Aspects, namely:
   1) Community Income
   2) Livelihood Guarantee
   3) Residential Sustainability
   4) Community survival

c. Socio-Cultural Aspects, namely:
   1) Customs / Laws
   2) Citizen life
   3) Local culture
   4) National culture
   5) Public and Private Public Relations

3.3. Philosophical, Juridical, and Sociological Approaches

a. Philosophical Approach

According to Supriyatna (2014), the Philosophical Approach to the concept and role of Coastal Reclamation on national resilience can be carried out in the geopolitical and geostrategic concepts of a nation. Geopolitics is defined as a political system or regulations in the form of national policies and strategies that are driven by

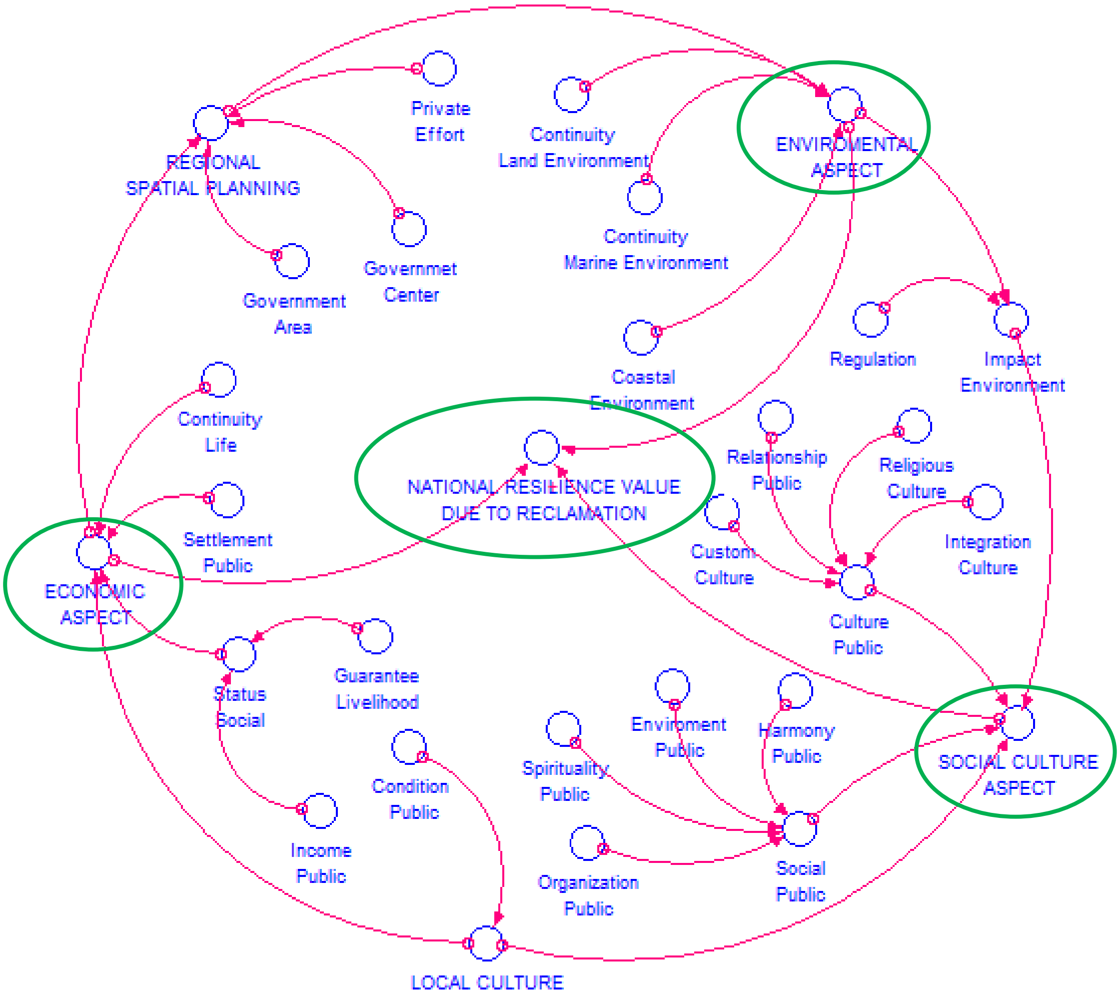

Figure 1. Identification of the Concept of Cause and Effect Relationship Factors Coastal Reclamation against National Resilience (Yustiana et al, 2021)

national aspirations based on geographic conditions, meaning that the emphasis is on geographic, territorial, or territorial considerations, which, if implemented and successful, will have a direct or indirect impact on the system. politics of a country. On the other hand, state politics will directly affect the geography of the country concerned. Geopolitics rests on social geography (geographic law), regarding geographical situations, conditions, or constellations and everything that is considered relevant to geographic characteristics.

Supriyatna (2014), the concept of Geostrategy is a strategy to take advantage of the geographic conditions of the State in determining policies, objectives, means to achieve national goals (utilization of environmental conditions in realizing political goals). Indonesian geostrategy is also defined as a method for realizing the ideals of the proclamation as mandated in the preamble and the 1945 Constitution. Geostrategy is needed to realize and maintain national integration in plural and heterogeneous society based on the Preamble and the 1945 Constitution. Indonesian geostrategy is formulated in the form of National Resilience. The concept of geopolitics and geostrategy in Indonesia is not essentially developing power for control over areas outside Indonesia or for expansion of other countries, but a strategic concept based on conditions of methods, or ways to develop the potential of national power aimed at safeguarding and maintaining the integrity of the Indonesian State's sovereignty and national development from disturbances that come from within and from abroad. To realize Indonesia's geostrategy, it was finally formulated with National Resilience.

According to Marsetio (2014), the geographical characteristics of the Indonesian state have the characteristics of a large influence on policies and strategies, both in efforts to create national welfare and national security. The influence of Indonesia's geographical position includes aspects of Pancagatra, namely ideology, politics, economy, socio-culture, and defense, in addition to Trigatra aspects, namely aspects of geography, demography, and natural resources which usually include aspects of management, utilization, and security. Therefore, every decision taken by the Indonesian nation, in National Development, must always be linked to the geographic characteristics of the Indonesian territory, and be oriented towards a prosperity and security approach in all aspects of national life, both natural (static) aspects. and social aspects (dynamic).

Indonesia's geopolitics and geostrategy originate from the awareness that this nation and state contains many divisive elements which at any time can explode and tear the unity and integrity of the nation. Ethnic, religious, racial, and inter-group sentiments that are blindly eliminated, the majority must be tolerant, while the minority must be proportional. Based on the latent threat, especially in the form of ethnicity, religion, and race, Indonesia's geostrategy as a development doctrine must contain methods of forming resilience and forming the resilience of the nation and state. The nation's community must continue to be fostered for their tenacity to be able to show their resilience and tenacity in deterring the elements that divide the nation and state, both from outside and from within, especially in the activities and policies of Coastal Reclamation which affect the National Resilience of an area of the region.

b. Juridical Approach.

From a juridical perspective, the role of Coastal Reclamation on National Resilience can be carried out following the vision and mission of a strong and resilient Indonesian development and must be implemented in the context of Indonesia as a juridical state following the current law. This means that all efforts towards the development of a Maritime State must be supported and based on legal regulations that give legitimate power to all stakeholders.

The 4th paragraph of the Preamble to the 1945 Constitution implicitly explains that marine development fulfills at least 4 (four) objectives, namely public welfare, education, defense and security, and international peace. Then, Article 25A of the 4th amendment of the 1945 Constitution, states that "the Unitary State of the Republic of Indonesia is an archipelagic country characterized by an archipelago with its territory and boundaries and rights stipulated by law." as a goal as mandated by law. The governing legal dimension must also include national law and often come into contact with international law. Of course, with such rapid changes and acceleration of regulatory substances.

Therefore, the development of coastal reclamation laws and policies must be able to move in line with the acceleration of changes in the global regulatory map and be able to answer regulatory needs at the national and regional levels. As a country that has fought for the legal aspects of its national territory status in the Archipelago State through the Djuanda Declaration in 1957, juridical developments as a basis for empowering Indonesia's maritime and maritime potential must continue to run, including the coastal reclamation policy. This process has developed quite rapidly in line with the process of national dynamics and is influenced by developments in the strategic environment both regionally and globally.

Article 62 Unclos 1982 which contains provisions on the obligations of the coastal state to provide opportunities for the exploitation of fishery biological resources in EEZ waters also strengthens the legality aspect of being an archipelagic country. Then the implementation of the Marine Law, 2005-2025 National RPJP, Shipping Law, Water Law, and other maritime regulations. Law Number 17 of 2007 concerning the Appendix section regarding the Vision and Mission of National Development for 2005 - 2025 contains the vision for Indonesia's development, namely an Indonesia that is Independent, Advanced, Just and Prosperous. The seventh mission of the 2005–2025 national development is "Realizing Indonesia as an archipelagic country that is independent, advanced, strong, and based on national interests".

The meaning of this mission is to foster welfare-oriented development for the community and government, as well as to increase the comprehensive and sustainable use of human resources, national marine areas, and marine technology for the benefit of the sovereignty and welfare of the Indonesian nation.

Coastal Reclamation is one of Indonesia's potential resources, indeed it needs to be managed optimally and sustainably to realize Indonesia's ideals to provide maximum benefits for the prosperity of the people. Based on this, on February 20, 2017, President Joko Widodo has signed Presidential Decree No. 16 of 2017 concerning the Indonesian Maritime Policy, but must still take into account the conditions of the National Resilience of the local community.

The spatial layout of the coastal reclamation area must pay attention to the social, economic, and cultural aspects of the reclamation area, as follows: a) Coastal reclamation has a transitional impact on the pattern of social, cultural, and economic activities as well as the habitat of community water spaces before reclamation. Changes that occur must adjust to 1) The change in function of the area and the pattern of spatial areas; 2) Furthermore, the above changes have implications for changes in the availability of new types of employment and forms of diversification of new businesses being offered. b) Social, cultural, tourism, and economic aspects that are accumulated in the social, cultural, tourism, and economic networks of the coastal reclamation area utilize the water / coastal space. The Indonesian Government's policy following the Minister of Public Works Regulation Number 40/PRT/M/2007 concerning Guidelines for Spatial Planning for Indonesian Coastal Reclamation Areas is general guidelines that must be implemented properly and sustainably taking into account Indonesia's National Resilience.

c. Sociological Approach

According to Supriyatna (2014), the Sociological Approach to the concept and role of coastal reclamation on National Resilience needs to be carried out as a guide in the implementation of national development and regional development, especially in the maritime sector, from the planning stage, the implementation stage to the evaluation stage. For its implementation, the conception of national resilience in a sociological approach in the field of maritime culture needs to be described in a more operational framework of sociology, as described in the following sections:

1) Implementation of sociological aspects of Community National Resilience.

Understanding the appreciation and practice of archipelago insights and national resilience in the field of maritime culture and reclamation activities should be started from each individual, increasing family, groups and community groups and community organizations, by thinking, behaving and acting always prioritizing unity and integrity, helping to preserve the environment. live and do not act "counter-productive" against national resilience, especially in the field of national maritime culture and actions that weaken national resilience in the maritime sector (Subekti, 2010)

2) Implementation of sociological aspects of the National Resilience of the Nation

The reform movement in the field of national maritime culture, besides having a positive side, namely demanding various improvements, especially in the fields of politics, economy, and law also has a negative side if there is no "law and order" which can endanger national unity and especially in the field of national maritime culture. The sources of these divisions can gradually be overcome, if all components of the nation, especially state administrators, political elites, and the young generation of the nation, live up to national ideals and goals as well as the concept of archipelago insight and national resilience, especially in the field of maritime culture (Subekti, 2010).

3) Implementation of the sociological aspects of the National Resilience of the State

In the life of the state, the aspirations of the community, the interests of groups, regions, the field of national maritime culture need to be accommodated and processed by the supra structure seriously, referring to the ideal foundation: Pancasila, the constitutional foundation: the 1945 Constitution, and the visional foundation: the insight of the archipelago and the conceptual foundation. : national resilience, a decision as outlined in-laws and regulations and development programs, especially those that support the maritime culture concept policy.

So it can be concluded that the implementation of sociological aspects of National Resilience in Society, Nation, and State must be carried out in the main aspects of Coastal Reclamation activities that affect the National Resilience of a region or region.

4. CONCLUSION

This research has produced a comprehensive study analysis of the impact assessment of Coastal Reclamation which affects the National Resilience of a particular area or area. Identification of aspects in detail through critical and literary studies is needed to obtain variables and criteria that have a significant effect on National Resilience as a result of coastal reclamation. Activities start from a comprehensive understanding of the system that occurs through a critical review of previous research. As for based on observations and critical studies of previous research, which is followed by the preparation of significant factors from the environmental, economic, and socio-cultural aspects as an interacting system factor.

In the final section, an analysis of physiological, juridical, and sociological approaches is carried out to strengthen the results of this study. A philosophical approach to the concept and role of Coastal Reclamation on national resilience can be carried out on the geopolitical and geostrategic concepts of a nation. From a juridical perspective, the role of Coastal Reclamation on National Resilience can be carried out following the vision and mission of a strong and resilient Indonesian development and must be implemented in the context of Indonesia as a juridical state following applicable law, meaning that all efforts towards development must be supported and based on regulations. The law gives legitimate power to all the interests of society. Whereas the sociological aspect approach to national resilience, is focused on National Resilience in Society, Nation, and State according to the main aspects of Coastal Reclamation which affect the environment, economy and socio-culture.

5. FUTURE WORK

This research can be continued and can be developed further towards a more detailed policy formulation to assess the relationship between variables that affect the aspect of coastal reclamation on National Resilience. The data analysis method can use the System Dynamic method because National Resilience is a dynamic assessment in time and spatial dimensions or location as the impact of coastal reclamation as an interacting system.

The stages of data analysis and processing using a Dynamic System in further research can be carried out in the following steps:

a. Understanding the complexity of the Coastal Reclamation System on National Resilience.
b. Identification and definition of problems in the system.
c. Identification of all Aspect Variables and Criteria
d. Preparation of Dynamic Loop System Causal Diagrams in the form of all coastal reclamation system variables that affect National Resilience.
e. Compilation of Dynamic Stock and Flow System for all system variables
f. Compilation of the Formulation and Formulation of the National Resilience Value Model.
g. Perform Internal and External Model Validation to Experts
h. Conducting Model Simulation for National Resilience Policy and Assessment.
i. Analyze and evaluate the simulation of coastal reclamation policies against the expected National Resilience Value.
j. Choose the best policy.

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ANALYSIS OF INDONESIAN WARSHIPS SELECTION IN SUPPORTING MARITIME TASK FORCE (MTF) IN LEBANON IN SUPPORTING THE MISSION FOR WORLD PEACE

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ABSTRACT

World Peace Forces, or what we often call the Garuda Contingent (KONGA), is the Indonesian National Army troops assigned as troops peace in another country. Indonesia began to participate in sending forces as part of the UN peacekeeping force in 1957. Indonesia sent the Warship of the Republic of Indonesia (KRI) to maintain peace under the United Nations flag at the United Nations Interim Forces Mission in Lebanon (UNIFIL) for the first time in 2009. This activity aimed to maintain security stability in the Lebanese area. This was because Lebanon was one of the countries that were experiencing conflict in the Middle East area. So far, the Indonesian Navy has sent twelve MTF Task Force to Lebanon with using six KRI, namely KRI Diponegoro-365, KRI Sultan Hasanudin-366, KRI Sultan Iskandar Muda-367, KRI Frans Kaisiepo-368, KRI Bung Tomo-357, and KRI Usman Harun-359. In the previous section, the Indonesian Navy still has Van Speijk Class as the frigate warship. And Indonesian Navy also has PKR 10514 as the new frigate class. Along with the continuity of the task force, consideration was needed in determining the warship that continues the mission. It was necessary to weigh the criteria using the Analytical Hierarchy Process (AHP) method in determining the warships that meet these criteria. The following selected warships would continue the warships that have previously carried out the maritime task force mission in Lebanon.

Keywords: *Maritime Task Force (MTF),* Indonesian Warship selection*, Analytical Hierarchy Process (AHP).*

1. INTRODUCTION

World Peace Forces, or what we often call the Garuda Contingent (KONGA), is the Indonesian National Army troops assigned as troops peace in another country. Indonesia began to participate in sending forces as part of the UN peacekeeping force in 1957. The World Peace Force is divided into 2, namely the Army Task Force (ATF) and the Maritime Task Force (MTF). And for the division of its territory consisting of several countries, Haiti, Congo, Sudan, and Lebanon. The delivery consists of 3 forces, namely, the Indonesian Army, the Indonesian Navy and the Indonesian Air Force; the three forces are members of the Army Task Force or ground troops. Meanwhile, the Maritime Task Force comes explicitly from the Indonesian Navy. The matter is because the Maritime Task Force consists of an Indonesian Warship inside it.

The Garuda XXVIII contingent (Indo MTF Force) is Indonesia's contribution to United Nations activities in Lebanon. This activity itself starts on 16 March 2009 by sending KRI Diponegoro 365 to join the MTF (Maritime Task Force) UNIFIL. This is the first time Indonesia's participation in the task force MTF, with the first task force named Konga XXVIII-A, which until now has existed 11 MTF Task Force from Indonesia dispatched to Lebanon. This activity aims to maintain security stability in the Lebanese area. This is because Lebanon is one of the countries that is experiencing conflict in the Middle East area. And currently, the main task of the MTF Task Force in Lebanon is to prevent the flow of weapons from entering Lebanon by sea. In addition, the MTF Task Force has a supporting task in evacuating Indonesian citizens and victims from local civilians to the nearest country, in this case, Turkey and Cyprus, if there is conflict in Lebanon.

In operation, the MTF Task Force is the same as the ATF Task Force, which is located under the Indonesian National Army Headquarters (Mabes TNI), in this case, the Mission Center Maintenance of Peace for the Indonesian National Army (PMPP). So, it's deep the operation of this Task Force starts from the need for personnel support to The Task Force material support comes from TNI Headquarters. Meanwhile, the TNI Headquarters itself is in its implementation has the full support of the United Nations (UN) as compensation for TNI's participation in this activity.

The Indonesian Navy contributes to world peace. The form of this contribution can be seen from sending approximately 1828 Indonesian Navy troops to Lebanon to help guard the sovereignty of the country. They are members of the Maritime Task Force (MTF) TNI Garuda Contingent XXVIII-C / United Nations Interim Force in Lebanon (UNIFIL). In the total UNIFIL MTF sent by the Indonesian Navy, there are two types of KRI: KRI type corvette class SIGMA (Ship Integrated Geometrical Modularity Approach) and KRI type MRLF (Multi-Role Light Frigate). But, by developing the Indonesian Navy in the complete filling of Minimum Essential Force (MEF), the Indonesian Navy has been added some frigate ships. They are PKR 10514 class. And in the previous section, Indonesia still has Van Speijk Warship class that still suitable to be delivered to this mission. So, from this kind of condition, we have to determine which warship that will be used as the main warship in the next Maritime Task Force (MTF).

On the other hand, there are several requirements for warships that can be sent on MTF missions. The KRI criteria or requirements that can be sent to the Unifil MTF Task Force, among others:

a. Able to operate Heli and then carry 1unit Heli BO-105 NV-414
b. Able to carry out Search and Rescue (SAR)
c. Able to carry out RAS (Filling BBM at sea)
d. Has class I health facilities
e. Has a real-time Combat Management System (CMS).
f. Able to carry out self-protection
g. Has the ability to identify friends/foes
h. Able to provide assistance to the Lebanese Navy

In this research, we try to predict and help the Indonesian Navy to decide the next ship that probably to be used in the Maritime task Force (MTF) in Lebanon. And in this research, we will use Analytical Hierarchy Process (AHP) to decide it.

2. LITERATURE REVIEW

2.1 United Nation (UN) Missions

Since 1957 Indonesia has been actively invited to participate in sending a contingent of peacekeeping troops under the UN flag, but the troops sent are ground aspect troops which contain the composition of the combined dimensions of the Indonesian Army, Navy and Air Force. Meanwhile, the TNI MTF Task Force only consists of Indonesian Navy Soldiers manning the KRI. This clearly shows the appreciation and trust of the international community for Indonesia's maritime defence forces. The achievements of the Indonesian Navy are a manifestation of the demands for the duties set out in article 9 letter c of Law Number 34 of 2004 concerning the TNI.

2.2 Maritime Task Force (MTF)

The implementation of government policies for sending the TNI MTF task force to the UNIFIL mission will continue in accordance with the agreement in the Memorandum of Understanding / MOU between the Indonesian Government as a Troop Contributing Country / TCC and the UN, whose deadline is not stated. Until now, the Indonesian Government continues to decide to send KRI on this mission. With the existence of an MOU from the UN, the Indonesian Government, in this case appointing the Indonesian Navy as the executor, must determine or choose the KRI to be used in carrying out the mission.

In 2009, for the first time, Indonesia sent the Republic of Indonesia Battleship (KRI) on a peacekeeping mission under the United Nations flag at the United Nations Interim Forces Mission in Lebanon (UNIFIL) mission involving marine elements KRI Diponegoro-365 (MTF-1). Furthermore, in 2010 sent the Indonesian Konga XXVIII-B / UNIFIL 2010 Maritime Task Force KRI Frans Kaisepo-368 (MTF-2), in 2011 sent the Konga XXVIII-C / UNIFIL TNI Maritime Task Force 2011 KRI Sultan Iskandar Muda-367 (MTF-3), and in 2012 sent the Maritime Task Force Konga XXVIII-D / UNIFIL 2012 KRI Sultan Hasanuddin-366 (MTF-4), the second time the KRI Diponegoro Task Force Maritime Task Force (MTF) Konga XXVIII-E / UNIFIL 2013. The Maritime Task Force (MTF) Garuda Contingent (Konga) XXVIII-F / United Nation Interim Force In Lebanon (UNIFIL) in 2014 was KRI Frans Kaisiepo-368.

In fact, in 2015, the KRI Diponegoro-365 class SIGMA (Ship Integrated Modularity Approach) corvette ship will be replaced with the KRI Bung Tomo-357 class KRI-357 KRI frigate to be sent to carry out duties in Lebanon. The time that lasted for more than five years, the KRI election only took turns from the KRI SIGMA and MRLF, which were just purchased from England in 2015, so this resulted in less efficiency in various aspects, including optimization of sensors, platform, fuel efficiency, accommodation, weaponry, personnel and support equipment.

2.3 Minimum Essential Force (MEF)

By the national defence policy set by the Ministry of Defense, the development of the Indonesian Navy's strength is bound to the Minimum Essential Force (MEF). MEF is a force designed to have a particular ability (Capability Design) to face threats to protect and protect the country's sovereignty, the integrity of the Republic of Indonesia and the safety of the entire nation. The possible risks that will be faced when the threat is greater than the capability designed for national and international goals and interests.

In a world peace mission, it is necessary to select the right KRI to carry out the task in accordance with the MOU issued by the United Nations for ships that will participate in carrying out the mission. Taking into account the human rights functions, policies and financial conditions of the country, there are several steps that can be taken to meet the MEF that has been established either by maintaining defence equipment or utilizing new procurement. For this reason, the KRI, which is part of the TNI AL's leading defence equipment needed, is expected to meet the requirements issued by the UN both from an operational, technical and administrative perspective so that the KRI's human functions in carrying out this mission can be fulfilled.

2.4 Multiple Criteria Decision Making (MCDM).

Multiple Criteria Decision Making (MCDM) is a decision-making method based on theories, processes, and analytical procedures that involve uncertainty, dynamics, and aspects of various criteria. In conventional optimization methods, coverage is generally limited to only one selection criterion (mono criteria), where the selection taken is the choice that best meets the objective function. However, the problems faced, especially those of a more practical nature, are not that simple. There are times when subjective considerations must be incorporated into the decision-making process. This condition causes the conventional optimization approach to no longer to be used.

MCDM provides an alternative to taking advantage of objective and subjective considerations as a basis for decision making. The problem with multiple criteria may be defined as a situation where a standard becomes a consideration for selecting an alternative that is used to:

a. Determine the best alternative or a set of the best options (choice problem).

b. Ranking the alternatives from best to worst (ranking problem), or divide the alternative set into alternative subsets based on multiple rules (sorting issues).

2.5 Analytical Hierarchy Process (AHP).

The Analytic Hierarchy Process (AHP) is a theory developed by Thomas Saaty for measuring intangible factors through paired comparisons using judgments from a 1 to 9 fundamental scale and resulting in priorities for the elements. It can be applied to both tangibles and intangibles and is used for decision making by structuring a hierarchical model with a goal, criteria (sub-criteria), and alternatives than making pairwise comparison judgments about the dominance of groups of elements in a level below concerning the component from which they are connected in the story above. In the end, the priorities of all the parts are synthesized to rank the alternatives. These simple hierarchies can be extended to multi-level decision models with rankings of benefits, opportunities, costs and risks.

The AHP has been applied in many areas, including resource allocation and conflict resolution. There are numerous intangibles that have a great impact that we must first measure before we can include them as variables. What is most significant is that intangibles can only be measured through expert judgment and only relative to the goals of concern in a particular situation. In this study, AHP is used to measure the intensity or weight of each leading aspect of each technology component by analyzing using pairwise comparisons of each criterion. Three basic principles of the AHP process: (Saaty, 1993).

a. Describe and describe a hierarchy called arranging hierarchically, which is to break down the problem into separate elements.

b. Differentiation of priorities and systems, which is called priority setting, is to determine the level of elements according to their relative importance.

c. Logical consistency, which ensures that all elements are grouped logically and ranked consistently according to a logical criterion.

2.6 Pairwise Comparison

Pairwise comparison based on the judgment of the decision-maker by assessing the importance of an element compared to other factors. This comparison value is determined by the quantitative scale proposed by Saaty (1994). This scale starts from 1 to 9. Comparisons are made until a total judgment is obtained of n x [(n-1) / 2] pieces, where n is the number of elements being compared.

Table 1. Scale of Intensity of Importance

Intensity of Importance	Definition
1	Equally important
2	Between equally and moderately important
3	Moderately important
4	Between moderately and strongly important
5	Strongly important
6	Between strongly and very strongly important
7	Very strongly important
8	Between very strongly and extremely important
9	Extremely important

3. RESULTS AND DISCUSSION

3.1 Identification of Criteria and Sub criteria.

This section is carried out utilizing brainstorming/interviews with the speakers. The resource persons consisted of experts from:

a. Operations Staff of Indonesian Armed Forces Peacekeeping Center (PMPP)

b. Operations Staff of Indonesian Navy Headquarter

c. Planning Staff of Indonesian Navy Headquarter

d. Logistics Staff of Indonesian Navy Headquarter.

The result of this stage is the identification of the initial criteria and sub-criteria in determining the type of warship, which are as follows.

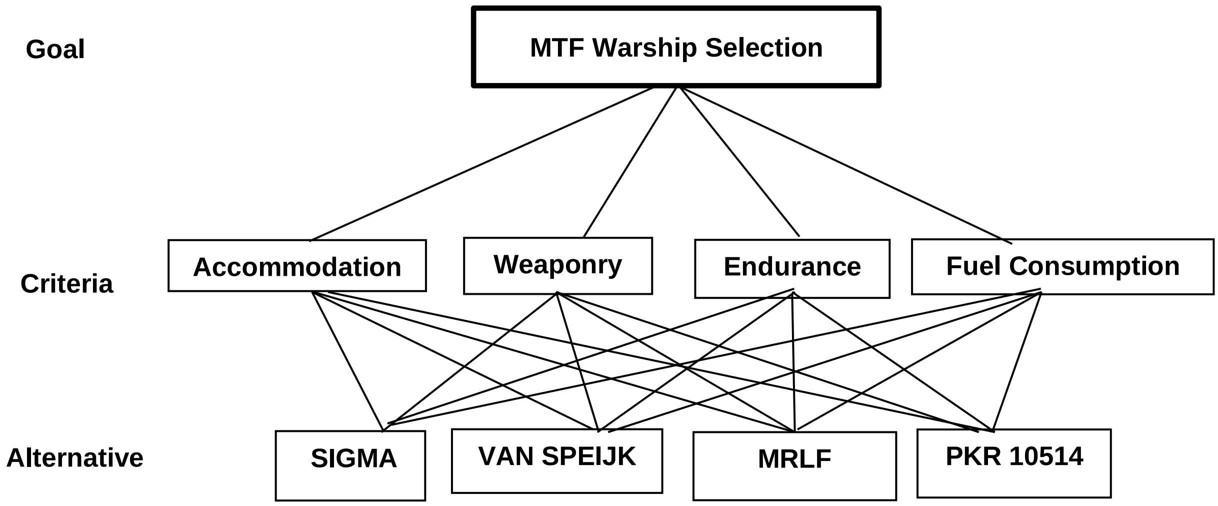

Figure 1. Hierarchy Diagram

Table 1. Description of Criteria

No.	Criteria	Description
1	Accommodation	Includes facilities and equipment the warship includes beds, dining facilities, toilet facilities along with other supporting facilities
2	Weaponry	It covers all types of weaponry available on the warship along with the supporting weapon sensor facilities
3	Endurance	It covers the ability of warship to survive in doing Operations at sea
4	Fuel Consumption	It covers the ability to consume KRI's fuel inside carry out operations at sea

3.2 Determination of Alternative Priorities

Using the AHP method, the weight value is obtained for each of the criteria and sub-criteria in selecting the type of warship. The results of weighting the criteria and sub-criteria. And then, the data processing using Expert Choice software, which can manage the relationship between standards, between sub-criteria or between alternatives, provides the final calculation result in the form of a ranking value of the priority of each option to determine the type of warship.

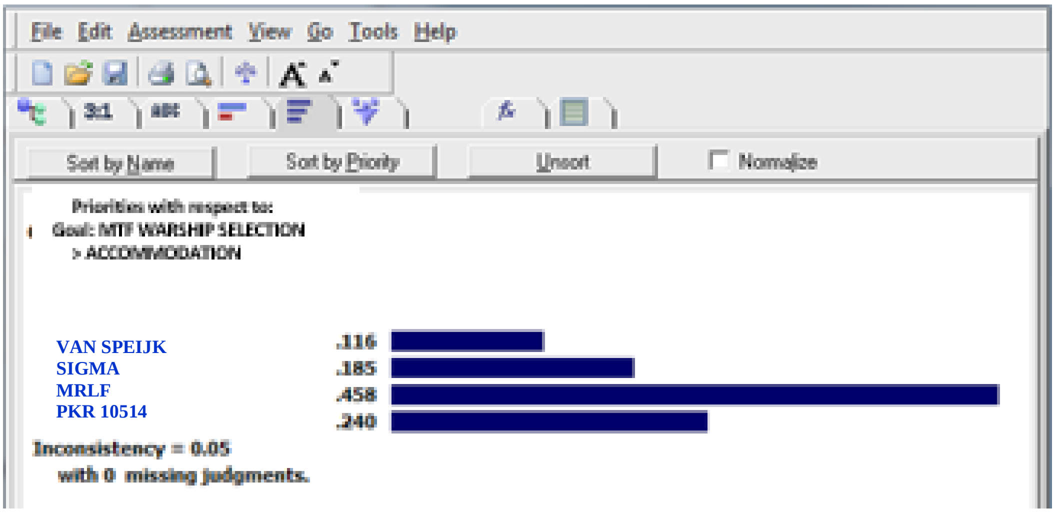

Figure 2. Value of Accommodation

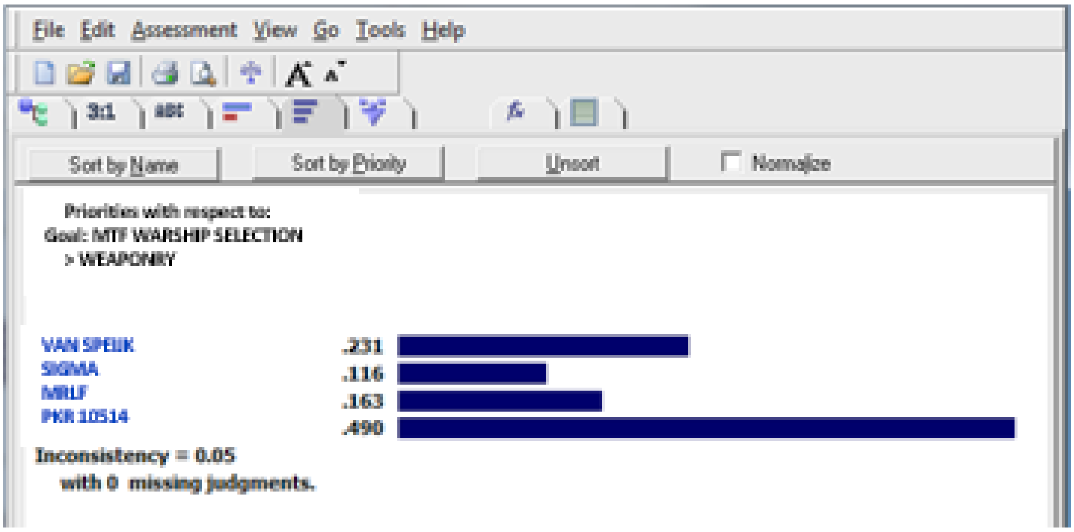

Figure 3. Value of Weaponry

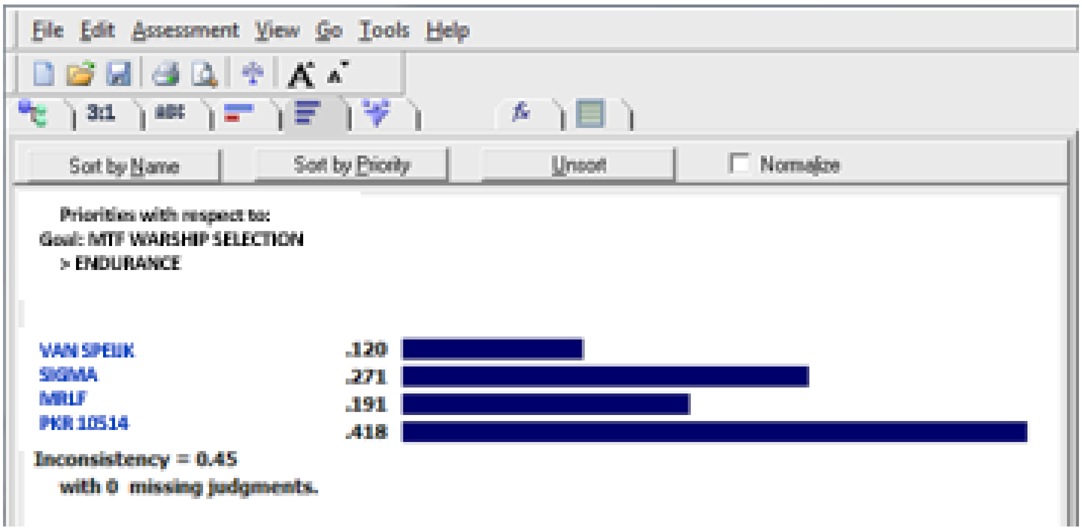

Figure 4. Value of Endurance

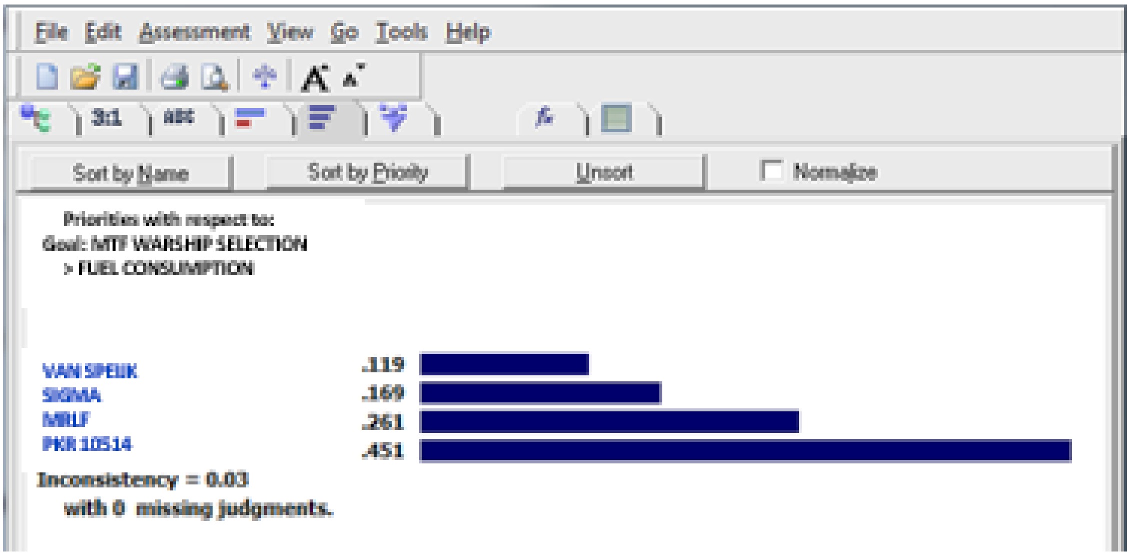

Figure 5. Value of Fuel Consumption Criteria

From the picture above, it can be seen that the alternative priorities are based on the weight value of each criterion. The alternative priority ranking is in accordance with the table below.

Table 2. Priority Ranking for Types of MTF Warships

Rank	Type of Warship	Weight
1	PKR 10514	0.346
2	MRLF	0.256
3	SIGMA	0.249
4	VAN SPEIJK	0.150

Based on the results of the calculation of the expert choice above, it is known that the warship type PKR 10514 was chosen as the top priority to be dispatched to the Maritime Task Force with a score of 0.346.

3.3 Sensitivity Analysis

The priority weight obtained from the results of the assessment data processing is highly dependent on the hierarchical structure developed and on the relative pairwise comparison given from various problem elements. Changes in the hierarchy or ratings can change the weighted priority generated.

Basically, the results of the previous calculations describe an ideal situation. To anticipate changes from previous estimates, a sensitivity analysis is carried out against these estimates. Sensitivity analysis is carried out to determine the extent of the stability of the priorities of the alternatives.

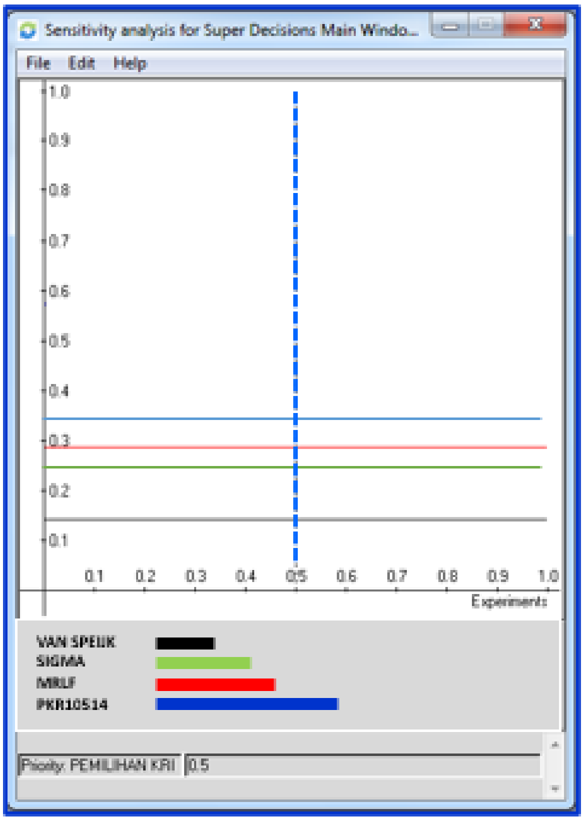

Figure 6. Warships Alternative Sensitivity Diagram

This test can be carried out on all sub-criteria that are used to ensure the level of sensitivity, the results of testing all sub-criteria.

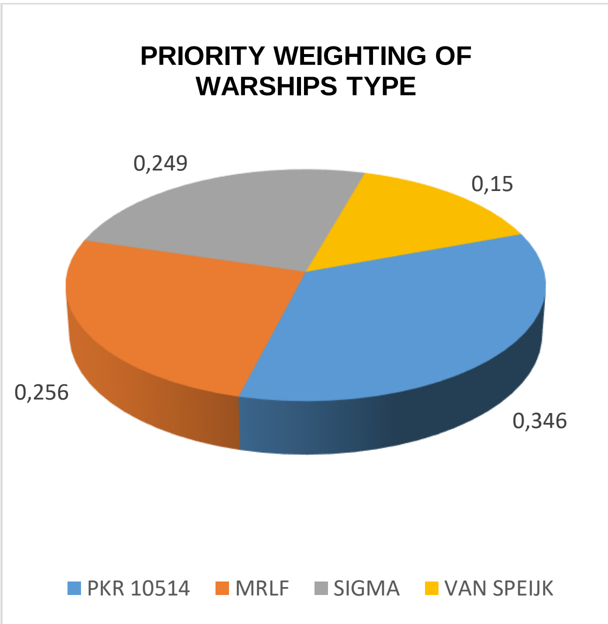

Figure 7. Priority Weighting Diagram

From the diagram above, we can see that PKR 10514 (0,346) has the highest weighting score that was followed by MLRF (0,256), then SIGMA (0,249) and the lowest score was Van Speijk (0,150).

4. CONCLUSION AND SUGGESTION

4.1 Conclusions.

From the discussions above we can take conclusions as follow:

a. Based on the results of calculations using the Analytical Hierarchy Process (AHP) method, it is known that the PKR 10514 has advantages over other types of warships, especially in the criteria for weaponry, endurance and fuel consumption.

b. Based on the results of the calculation of the expert choice on the selection of warships in Maritime Task Force (MTF), the PKR 10514 (0.346) has the highest weighting score that was followed by MLRF (0.256), then SIGMA (0.249) and the lowest score was Van Speijk (0.150).

4.2 Suggestions.

From the conclusions above we can give suggestions as follows:

a. It is crucial for the Indonesian Government, especially the Indonesian Navy, to replace the Maritime Task Force (MTF) warships in order of rejuvenation.

b. The Indonesian Navy must prepare PKR 10514 both in terms of Platform and Sewaco to replace the previous MTF warship so that the replacement process goes well.

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ANALYSIS OF FACTORS INFLUENCING THE INCREASE CAPACITY FACILITIES SURABAYA MAINTENANCE AND REPAIR ON THE WARSHIPS REPUBLIC OF INDONESIA THE HEADQUARTERS COMMAND FLEET 2.

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ABSTRACT

The ability to carry out the maintenance and repair of Warships of the Republic of Indonesia / naval vessels is a concept used in assessing the achievement of work with time parameters and measures of success. Budget, infrastructure and human resources have an important role in the task of maintenance and repair facilities surabaya. Every maintenance and repair always expects the implementation of the work to be completed on time, and the maximum results, so that the ability to maintain and repair needs to be maintained and improved on the implementation of the work. There are several alternative factors that can lead to improved maintenance and repair capabilities of warships of the Republic of Indonesia / Naval vessels including budget allocation, supporting infrastructure directly or indirectly as well as the readiness of human resources that include willingness, experience and expertise. These factors have an interconnected pattern. This study aims to find out the main factors that affect the improvement of the ability to maintain and repair KRI / KAL in mako koarmada II. In this study used a measuring instrument called dynamic system method with stella software. Factors that affect the improvement of capabilities in the literature can be from the literature whereas, the determination of the main factors that affect is done by modeling dynamic systems. This dynamic system modeling is done by creating a dynamic relationship between the factors that affect productivity. The data collection in this study uses secondary data from the process of maintenance and repair of fasharkan in Surabaya. The scale of the data used to determine the factors that influence the improvement of the ability is modeled in qualitative form. The result of modeling dynamic system factors that affect the improvement of capability is budget, infrastructure facilities and human resources factors that dominate are human resource factors.

Keywords: *Proficiency, Dynamic System, Stella Software*

1. INTRODUCTION

Addressing the demands of the Navy is large, strong and professional required a large maintenance and repair facilities, complete equipment and human resources experts in their fields and good cooperation (Team Work) in accordance with technological advances. Based on the demands of these needs and the importance of technological mastery in handling modern equipment, the Navy Leadership decided to establish a Maintenance and Repair Facility (Fasharkan) Surabaya, according to Skep Pangarmatim Number Skep/28/I/1994 dated January 19, 1994. In the organization Fasharkan Surabaya consists of Machine Workshop, Electric Workshop, Bakap Workshop, Electronics Workshop, Weapons Workshop and Shipyard / Dock Workshop. On December 30, 2006 surabaya maintenance and repair facilities were converted into maintenance and repair facilities of warships of the Republic of Indonesia in line with the formation of the command of the fleet of the eastern Republic of Indonesia and on March 06, 2008 the maintenance and repair facilities of warships of the Republic of Indonesia were again converted into maintenance and repair facilities of Surabaya under the construction of the main base of the national naval army V until now. The existence of surabaya maintenance and repair facilities under the command of the main base V Surabaya is very important when viewed from the side of the defense area of the fleet command area of the Republic of Indonesia 2 and the Defense of the Maritime Territory of the Republic of Indonesia.

The above is based on several aspects of maintenance and repair facilities (Fasharkan) Surabaya as part of the organization of the main base of the Navy V, has the main task of providing services in terms of maintenance and repair to support the operational weapons of the Indonesian national army NAVY. surabaya maintenance and repair facilities are the only facilities of the Indonesian Navy national army base that is able to technically carry out the level of maintenance maintenance and maintenance of the middle level and maintenance of depot level. Faced with the current condition of Fasharkan Surabaya, with limited human resources capabilities, facilities and workshop support equipment, in providing maintenance and repair support for Navy ships located in Surabaya, it can be felt that the performance of Fasharkan Surabaya is still not optimal. Therefore, this study is expected to know the extent of Fasharkan's performance in supporting HarKan KRI, as well as to know the most influential factors and play a role in improving the ability of Fasharkan Surabaya. Bureaucratic reforms in the indonesian national army environment have a big impact on the pattern of coaching personnel of the Indonesian Navy, especially on the function of use and maintenance. The measure of the successful implementation of Bureaucratic Reform can be seen from the realization of the right organizational function and the right size and output measured in accordance with its core business (Mabes TNI, 2011). To know the effectiveness and efficiency of the work of an organization so that the results are in accordance with the expected, it is necessary to assess and calculate the workload of the organization (headquarters of the Indonesian national army AL, 2016). System dynamics is a methodology for studying complex systems. The system is an academic discipline created in 1960 by Dr Jay Forrester of MIT. In this field of study, the system is defined as a collection of elements that are constantly interconnected over time to form a complete unity. The underlying relationship between these system components is called the system structure. The term Dynamics refers to changes over time. Therefore, a system that exposes related variables to try to change over time. System dynamics are methodologies used to learn and understand how systems change over time. Application elements and variables that make the system vary over time are referred to as system behavior.

The objectives to be achieved from this study are to determine the factors that influence the improvement of the ability to improve the maintenance and improvement of KRI with dynamic systems, and the relationship between factors, as well as determine the factors that dominate.

2. METHODS AND TOOLS

2.1 Dynamic system software

Some software is used in describing dynamic system simulation models, such as Dynamo, Stella, PowerSim, and Vensim. In representing real systems, this study will use Stella Software to visually build simulation models using computers. Stella is a programming language that describes the model of a system as a simulation model. Some tools commonly used in putting together a simulation model, namely:

- Stock is a tool used to generate accumulated information in the form of the value of a parameter that goes into it.
- Flow is a tool that affects the value of stock that can flow one way or two directions. Converter is a tool used to convert inputs into outputs.
- Connector is a tool used to connect the parameters involved in the model.

Illustration of the tools contained in Stella Software is shown by Figure 2.1.

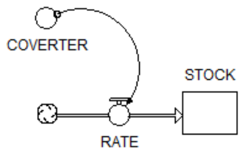

Figure 2.1 Tools Software Stella

2.2 Causal loop diagram

(CLD) is an important method used to demonstrate the feedback structure of the system. Causal loop diagrams are well used for:

a Quickly capture the hypothesis we are making regarding the cause of the dynamic.

b Bring up and capture the mental model of an individual or team.

c Communicate important feedback that is believed to be responsible for the problem.

The conditions for drawing causal diagrams are simple but must be followed appropriately. The causal diagram consists of variables connected by arrows that indicate causal influence between variables. Important feedback loops are also identified in the chart.

The variables are associated with a causal relationship, which is indicated by an arrow. For example, the birth rate is determined by both by population and by fraction of birth rate. Each causal relationship has polarity (shown in figure 2.20), be it positive (+) or negative (-) to indicate how dependent variables change when independent variables change (Sterman, 2004, p138). An important loop is represented by a loop identifier (shown in figure 2.21) that indicates whether the loop has positive feedback (reinforcing) or negative

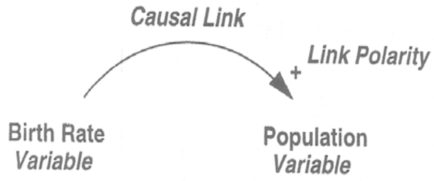

Figure 2.2. Polarity of Causal Relationships
Source : Sterman (2008)

A positive relationship indicates that if the cause increases, then the effect will increase above the previous one, and if the cause decreases, then the effect will decrease below the previous one. In figure 2.22, the increase in the birth rate fraction means that the birth rate will increase compared to the previous one, and the decrease in the birth rate fraction means that the birth rate will decrease below the previous one.

A positive relationship indicates that if the cause increases, then the effect will decrease below the previous one, and if the cause decreases, then the effect will increase above the previous one. For example, an increase in the average human lifespan means that the mortality rate will decrease below the previous one, and a decrease in the average human lifespan will increase the mortality rate above the previous one.

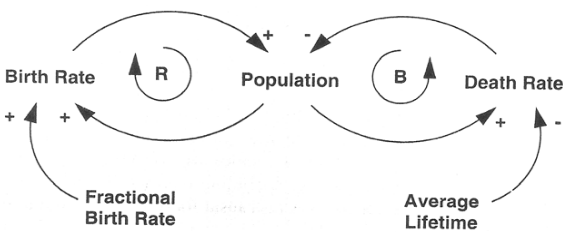

Figure 2.3 Example of Causal Loop Diagram (CLD)
Source : Sterman (2008).

2.3 Research Framework (Flowchart)

The research framework used to determine the factors that dominate the improvement of surabaya fasharkan ability from several factors in this study can be seen in Figure 2.4

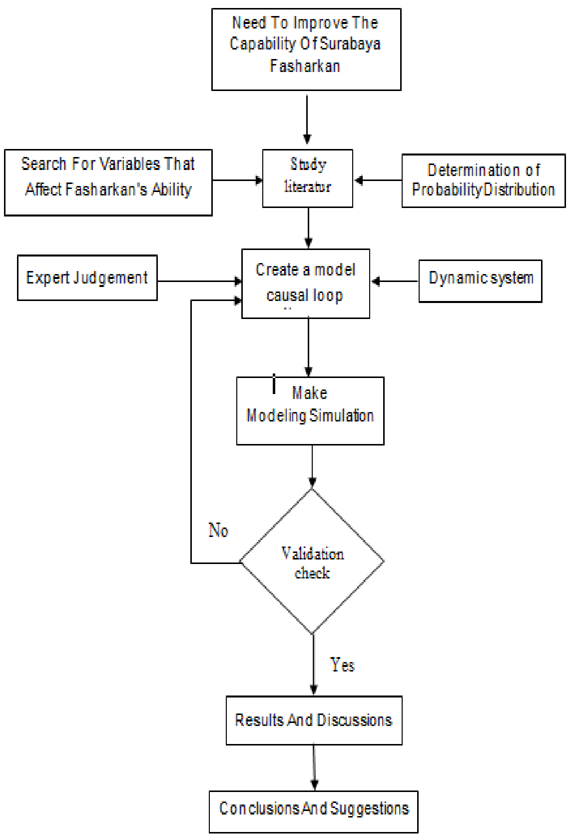

Figure 2.4 Research Flow Diagram.

3. RESULTS AND DISCUSSION

At the stage of data analysis, several steps will be taken to process the data that has been obtained before. Here is an explanation of each step.

3.1 Variables that affect the ability of

On variables that affect the ability of fasharkan made into 3 categories, namely: budget factors, human resource factors and infrastructure factors. From the respondent's data variables grouped into that category, the grouping results of the data variables are displayed in the Table

VARIABLE	CATEGORY
BUDGET	How to plan the budget of the program that has been determined and agreed.
BUDGET	How to implement the use of a predetermined and agreed budget
BUDGET	How the budget control system has been established and agreed
INFRASTRUCTURE FACILITIES	Influenced by how the procurement of equipment facilities supporting repairs, supporting funds and building facilities in carrying out maintenance and repair KRI / KAL.
INFRASTRUCTURE FACILITIES	How the status of equipment that has been owned by fasharkan Surabaya when compared to the development of current technology.
HUMAN RESOURCES.	Conditions how the ability of all personnel in completing and supporting the maintenance and repair of KRI / Kal.
HUMAN RESOURCES.	Conditions how the will of all personnel in completing and supporting the maintenance and repair of KRI / Kal.

Table 1. Variable Grouping Results.

The grouping of variables by ability category consists of: individually owned skills. Ability to interact with the work environment and personnel and Skills in the expertise of education, the category of Willingness to work consists of: Professionalism in work, Sense of responsibility in work, Leadership in work, mindset in understanding work, safety and health conditions in the project, satisfaction with the work carried out, level of competition between employees, and work experience. The result of the grouping of variables can be applied to dynamic system modeling using Stella, shown in Figure 3.

3.2 Causal Loop Diagram Design

At this stage will be described a variety of relationships between variables - variable shapers. Each corresponding variable will be linked by an arrow. The tail of the arrow indicates causation while the head of the arrow shows the effect of a cause. If the variable on the tail of the arrow changes directly to the variable on the arrowhead, then the arrow connecting the variable is positive (+). Whereas if the variable on the tail of the arrow changes inversely against the variable on the head of the arrow, then the arrow connecting the variable is negative (-).

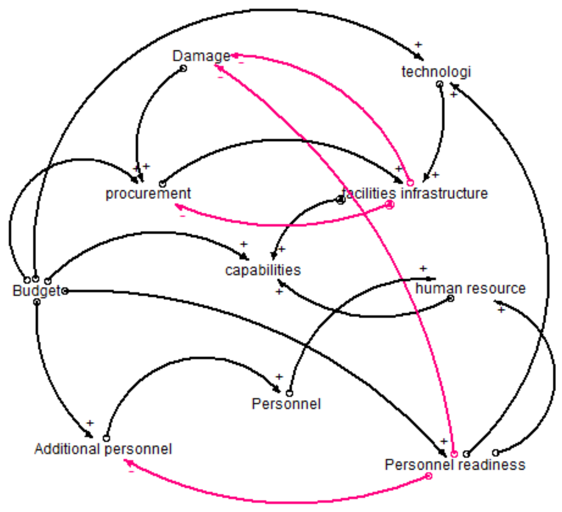

Figure 3.1. Causal Loop Model Diagram of Fasharkan Capability

3.3 Main modules

In the uatama module below is a description of causal relationships siatem with mutual influence. The main module image means that the improvement of the capability of surabaya fasharkan is strongly influenced by three factors including the budget sector, infrastructure sector and personnel readiness sector. Thus, the infrastructure sector is influenced by the budget sector and personnel readiness as well as affecting the sector's ability to repair and perssonil readiness. The same is true in the personnel readiness sector.

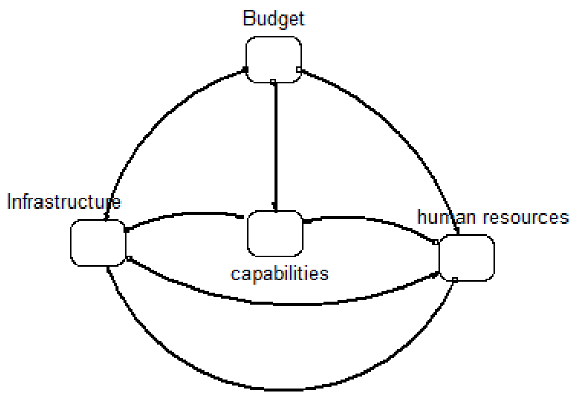

Figure 3.2 Main Models for Improving Fasharkan Capabilities.

3.4 Verification & validation

3.4.1 Verification

The next stage after the initial model simulation is the model verification and validation stage. This stage aims to ensure the model is verified and validated so that it can be ensured that the model is running properly. Model verification and validation also aims to find out if there are errors in the model. Verification and validation of models can also be a process to compare the structure of the model and its behavior to the structure and behavior of the system in its actual state, so that it can be said that the model is able to represent the real system. In this study verification was done by carrying out model unit tests while model validation was done by carrying out model structure tests and model parameter tests. Model unit tests and parameter tests are conducted with STELLA software while structural validation is carried out by expert judgement.

3.4.1.1 Verification is also referred to as source criticism. This activity is carried out by testing the validity of the source, which is seen from two types of criticism.

a External Criticism.

Testing the authenticity of source especially the accuracy of the historical document, such as the time of creation and material of the document

b. Internal Criticism.

Testing the level of credibility of the source is the evidence contained in the historical source by examining and analyzing the degree of error against testimony in history which is the most determining factor in the validity of the evidence or fact of history itself Interpretation or interpretation of history. Analyze and find relationships between facts with each other.

3.4.1.2 Verification Mode

Verification is a conformity test or logic accuracy model and checking for simulation program errors. This is done by examining the formulations, equations and parameter units on variable model variables. Model verification is done by checking for errors in the model either errors in variable units, or errors in the model created. If there is no error in the model, it can be said that the model has been verified. Verification conducted using STELLA simulation software is carried out by checking the unit (unit) as well as checking the formulation (equation) of variables from the model. Unit tests will ensure that the relationships between variables in the model have units that can be converted and valued. The verification process by unit test on STELLA software can be seen in Figure 4.1.

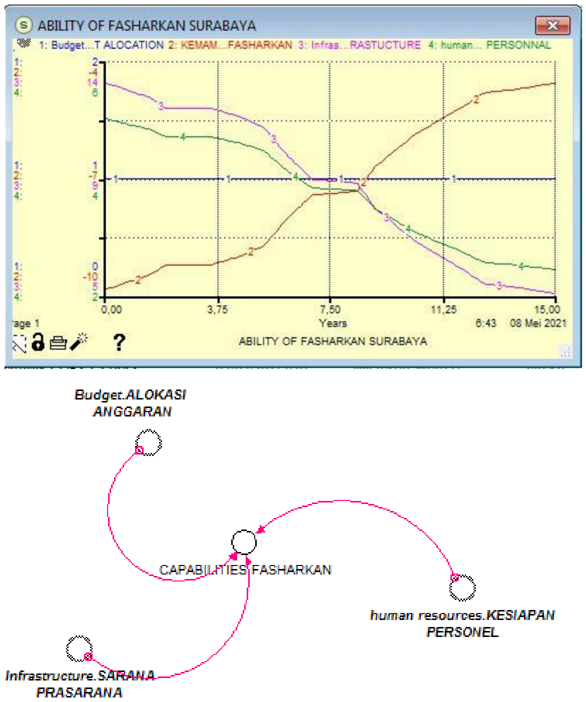

Figure 3.3. Model unit verification.

3.4.2. Validation.

Model validation is the process of determining whether a simulation model created can represent a real system appropriately. The validation process that will be done on the model is to compare the data on the model with the data on the real system. By running each simulation model, the output of the simulation result is obtained. Furthermore, from the simulation results are obtained to compare the resulting existing conditions (actual).

3.5 Budget allocation factors

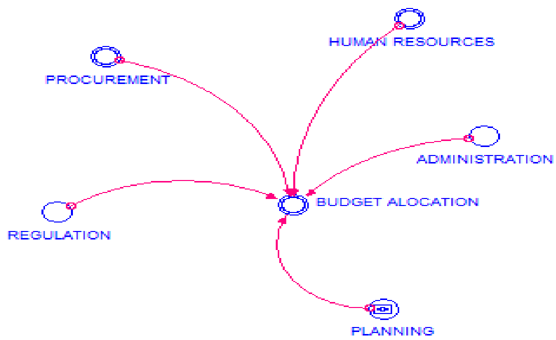

Figure 3.4. Creteria budget allocation

Budget allocation is very influential to efforts to improve the ability of surabaya fasharkan. the figure above measures the percentage value of applications and those affected by budget regulation, budget planning and budget control systems.

3.6 Human resource factors

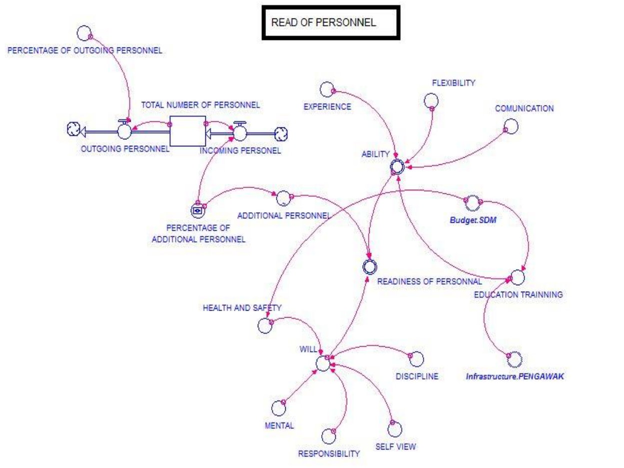

Figure 3.5. Human resources creteria

The above model is used to measure the extent of human resource readiness that greatly influences efforts to improve the capability of surabaya fasharkan in carrying out maintenance and repair activities KRI / KAL in the command headquarters of the fleet 2. Personel capability factors are strongly influenced by the experience of personnel during the ministry in the navy in the field of electricity KRI / KAL ship. Another factor that affects is the willingness of personnel mentally, selected work, have a sense of responsibility and can interact with the environment. Furthermore, another factor that affects is the capacity of personnel who serve as implementers of repairs.

3.7 Infrastructure factors

The model above shows the factor of kreteria factor that influences the main factors in the effort to improve the capability of surabaya fasharkan including equipment procurement system and technology that is currently used. There are several factors that affect the credibility of the equipment procurement system including materials used during repairs, working machines used and measuring instruments used. Technology kreteria factor is influenced by several alternative factors such as the equipment used, the readiness of personnel and the number of wak. All systems affect each other including budget allocation and human resource readiness.

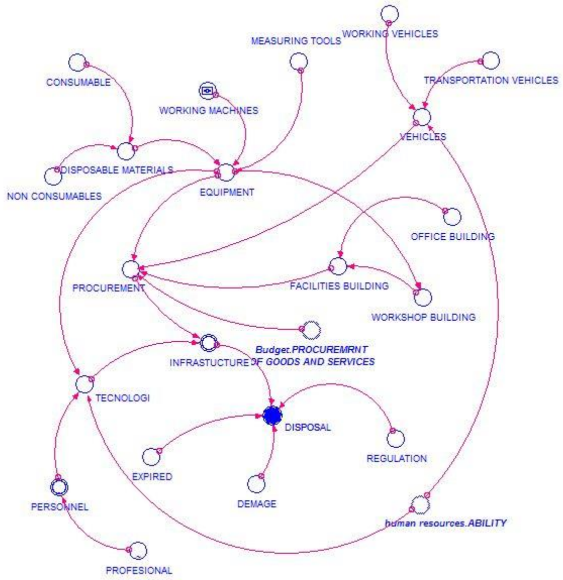

Figure 3.1. Criteria for infrastructure

4. CONCLUSION

Factors that affect the improvement of the ability of surabaya fasharkan is the kreteria factor of budget allocation, infrastructure and human resources.. Each factor of creteria is influenced by variables that affect, budget allocation factors are influenced by budget planning variables, budget regulation and budget control. infrastructure kreteria factor is influenced by the variable procurement of equipment and technology used, for the human resources kreteria factor is influenced by the ability, willingness and addition of personnel. Relationships between influencing factors using Dynamic System modeling using data distribution. Determination of dynamic system model simulation using Stella software..

a. The dominant factor that influences the improvement of the ability of fasharkan is the variable factor of human resources.

b. For further research can use primary data with dynamic system methods, in the hope that the final result of dynamic system modeling can be applied in the field.

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OPTIMIZATION OF NAVAL BASE LOGISTIC SUPPORT IN ORDER TO INCREASE THE ABILITY AS A BASE CARRIER IN SUPPORTING OPERATIONS UNITS

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ABSTRACT

The development situation of the regional strategic environment is still dominated by the South China Sea conflict (SCS) involving several countries in the ASEAN region. This conflict was mainly triggered by China's unilateral claims regarding the nine dash line area "(Minister of Defense, 2016). The Indonesian Navy has bases spread across various islands in the Republic of Indonesia and is divided into three Indonesian Fleet commands, namely Koarmada I in Jakarta, Koarmada II in Surabaya and Koarmada II in Sorong. Due to the many obstacles and differences in the character and socio-economic conditions of each area used as a base by the Navy, complex problems arise in determining policies in determining logistical support. This study aims to improve inter-island logistical support capabilities in supporting the Indonesian Navy's operational units. To examine the above problems, it is necessary to identify the threat trend using the content analysis method approach with the SWOT analysis method. In this approach, a proper ranking is also carried out in making decisions using the SWOT matrix calculation which can produce the best strategy formulation by giving the weight and rating of internal and external factors to the four quadrants so that it is known that the results are in quadrant III, which supports the turn around strategy with the difference. between the strengths and weaknesses of 0.18 while the opportunities and threats of 0.73.

Keywords: *Nine dash line, content analysis method with SWOT analysis method*

1. INTRODUCTION

The Indonesian Navy is a major component of state defense, especially at sea, has the main task of implementing national defense policies, namely maintaining state sovereignty and territorial integrity, protecting the honor and safety of the nation, carrying out War Military Operations and Military Operations Apart from War and actively participating in regional peacekeeping tasks. and international. This is in accordance with government policy regarding the concept of Indonesia as a World Maritime Axis (Presidential Decree No. 16, 2017). One of the main tasks of the Navy is to enforce sovereignty and law in the waters of national jurisdiction with the configuration of an archipelagic state where two-thirds of its territory is the sea.

This regional configuration results in high demands for the readiness and readiness of Indonesian Navy units to carry out operations, therefore the role of logistics is crucial to the success of the implementation of the Navy's Task (Kasal, 2010).

Anticipating the potential threat of conventional warfare due to violations of the Indonesian archipelago, it is necessary to prepare ourselves by building military forces for operational purposes. The success of an operation cannot be separated from adequate logistical support. Given that in addition to strategy and tactics, one thing that is dominant and very much supporting the achievement of victory is adequate logistical support for personnel and combat equipment used. Departing from the limited resources, researchers try to solve the Problems faced by bases so that logistical support can be carried out effectively and efficiently.

Currently the base conditions are found 3 main problems, namely the number of personnel that is still lacking, the anchoring facilities that are not optimal and the infrastructure that is not optimal. formulating a policy that is outlined in detail in the process of determining strategies and efforts to improve some of the obstacles faced in the field today.

2. LITERATURE REVIEW

2.1 Logistics Management Theory.

Logistic support is a part that considers effective and economical support (Benjamin S Blanchard, 1992). This is an integral part of the aspects of system planning, design and development, evaluation, results of construction / construction and its use. The main element of logistical support is maintenance planning which leads to the development of an integrated maintenance concept with various other supports.

The next main element is inventory support consisting of all spare parts including repairs, consumables parts, software, test equipment, transportation and handling equipment, training equipment and other facilities (documentation, procurement, material distribution, storage, personnel related to expertise and maintenance of inventory repair Next is the test and support equipment which includes all equipment, equipment for special monitoring equipment, diagnostics, calibration and metrology, positions for repair, service equipment and other necessary handling Then distribution and transportation which includes special storage, containers (reusable) and disposable), packing, moving goods and mobile facilities.Other elements are personnel and training, namely to get the personnel needed for installation, operation, handling and repair as well as the level of expertise according to the required fields supported by the facility itas, namely the means / place of activity. Then the data which includes manuals / procedures, technical drawings; and software related to programming data for monitoring and diagnosis.

2.2. Teori Integrated Logistic Support.

The function of Integrated Logistic Support is an integrated logistics support system / equipment that ensures that its implementation is carried out efficiently and effectively (Jacobsen & Scott, 1996) This will determine that all elements of logistical support are planned, obtained, used, controlled and provided with time and cost. efficient. The things that are fundamental in integrated logistics support are as follows:

a. Machining support.

Includes safety configuration and management.

b. Maintenance support.

Support that includes maintenance, repair to general overhoul level for support needs during operation and day-to-day operational support. Supply management integration is a series of activities that include coordination, scheduling and control of procurement, production, supply and delivery of products or services to users which includes daily administration, operations, logistics and information processing from users to suppliers.

d. Analysis of training needs and training support.

e. Distribution activities ranging from packing, shipping, storage and transportation to logistical support.

f. Professional human resources in handling logistics.

g. Technical data includes data logistics required.

h. Risk management.

i. Support base facilities.

j. Deletion.

2.3. SWOT Analysis Theory.

SWOT analysis is the systematic identification of various factors to formulate the strategy of an organization. This analysis is based on logic that maximizes Strengths and Opportunities, but simultaneously minimizes Weaknesses and Threats.

Research shows that the performance of an organization can be determined by a combination of internal and external factors. These two factors must be considered, the internal environment (Strengths and Weaknesses) and the external environment (Opportunities and Threats). The SWOT analysis compares the two factors.

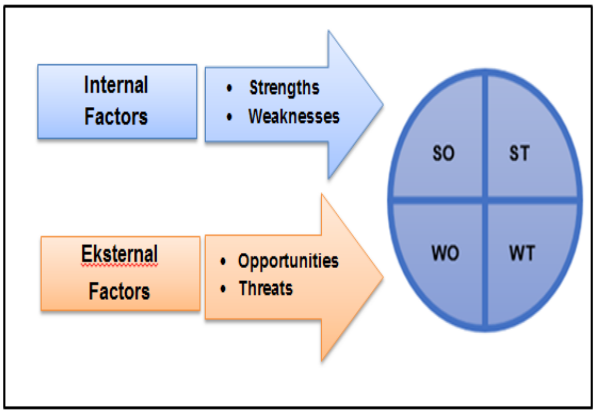

Figure 1. SWOT Matrix Analysis for Strategy Formulation

The planning process in a SWOT analysis goes through three stages, namely:

a. Data Collection Stage. At this stage the data obtained are classified into external data which are opportunities and threats and internal data which are strengths and weaknesses.

b. Analysis Phase. After collecting all the required data, a table of internal data and external data is created for external data, the table is called EFAS (external strategic factor analysis summary), while for internal data the table is called IFAS (Internal Strategic Factors Analysis Summary), then the two data are weighted as follows :

1) Arrange them in column 1 (5 to 10 opportunities and threats as well as strengths and weaknesses in each table).

2) Column 2 gives weight to each of the factors that have been made 1 (very important) to 0 (not important).

3) In column 3, calculate the rating for each factor by giving a scale ranging from 4 (out standing) to 1 (poor). For the rating value for the opportunity value is positive, the greater the opportunity is given a rating of +4, but on the other hand, if it is small, it is given a value of +1, this is inversely proportional to the rating for threats, as well as for strengths and weaknesses.

4) In column 4 is the result of multiplying the weight in column 2 with the rating in column 3.

5) In column 5 provide comments or notes on why certain factors were chosen and how their weighted scores were calculated.

6) Add up the weighted scores in column 4 to get the total weighted score, this value is a comparison of whether or not the external and internal environmental conditions can be used for further analysis to be complete and accurate with the SWOT matrix model.

7) The SWOT matrix can clearly describe how external opportunities and threats are adjusted to their strengths and weaknesses. The matrix is described as follows:

IFAS / EFAS	**Strengths (S)** Determine 5-10 internal strength factors	**Weaknesses (W)** Determine 5-10 internal weakness factors
Opportunities (O) Determine external opportunity factors	**SO Strategy** Create a strategy here that uses power to take advantage of opportunities	**WO Strategy** Create a minimizing strategy to utilize
Treats (T) Determine external threat factors	**ST Strategy** Create a strategy here that uses power to overcome threats	**WT Strategy** Create a strategy at minimize weaknesses avoid threats

Figure 2. SWOT Matrix Diagram

a) SO Strategy

This strategy is made based on the mindset of the organization, namely by utilizing all the power to seize and take advantage of maximum opportunities.

b) ST Strategy

This is a strategy in using the strength of the organization to overcome threats.

c) WO Strategy

This strategy is implemented based on the utilization of existing opportunities by minimizing existing weaknesses.

d) WT Strategy

This strategy is based on activities that are defensive and try to minimize existing weaknesses and avoid threats.

2.4. SWOT Analysis Diagram

a. Quadrant I:

Is a very favorable situation, the organization has the opportunity and strength of the strategy being implemented that is supporting aggressive growth policies.

b. Quadrant II:

There is a threat, but it still has internal strength, the strategy being implemented use the power to exploit long-term opportunities by means of a diversification (product / market) strategy.

c. Quadrant III:

Organizations face enormous market opportunities, but there are some internal obstacles / weaknesses. The strategy must be implemented by minimizing internal problems in order to seize market opportunities.

d. Quadrant IV:

Is a very unfortunate situation, the company faces various internal threats and weaknesses

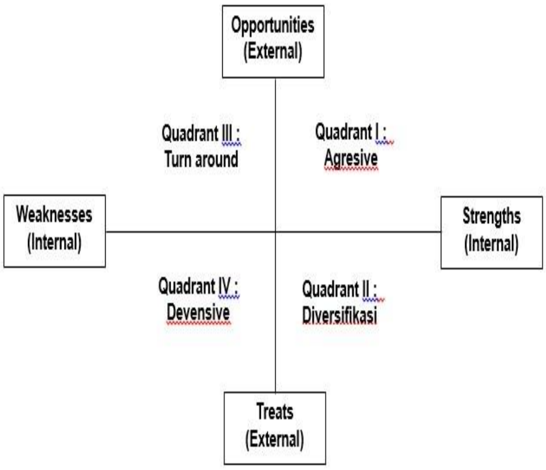

Figure 3. SWOT Analysis Diagram

2.4. Teori Metode Content Analysis.

Content Analysis is a research technique for making repicable and valid inferences with due regard to the context. As a research technique, content analysis includes specific procedures for processing scientific data with the aim of providing knowledge, opening new insights and presenting facts (Klaus Krispendoff, 1993). In this study, later it will not only use a quantitative research model but also use qualitative research methods so that in this study, researchers will examine documentary documents in the form of text, images and symbols which are combined into weighting and rating figures in the hope of knowing the first, second priority, third and so on.

Furthermore, as a scientific method, Content Analysis has a framework as a guideline for its use as proposed by Type (in Krippendorff, 1980: 35-36) as follows:

a. Pragmatic Content Analysis, which is a procedure to understand text by classifying signs according to their possible causes or consequences. (For example, counting the number of times a word is written or said, which can result in the appearance of liking or disliking a government regime.)

b. Semantic Content Analysis, which is a procedure that classifies signs according to their meaning. (For example, counting the number of times the word democracy is used as a reference as a choice of political systems adopted by most of the world's people). Or, for example, how many times the word Indonesia was mentioned by Obama as a reference to an example of a country with diversity of ethnicity, culture and religion, which is able to unite everything within the framework of a unitary state. In detail, Type develops Semantic Content Analysis into three kinds of categories as follows:

1) Designation Analysis, which is to calculate the frequency of how often certain objects (people, objects, groups, concepts) are referred to. This model analysis is also commonly referred to as Subject-Matter Content Analysis.

2) Attribution Analysis, which is to calculate the frequency of how often certain object characteristics are referred to or referred to. (For example, characterization of the dangers of using drugs for life)

3) Statement Analysis (Assertion Analysis), which is text analysis by calculating how often certain objects are labeled or given special characters. (For example, how often has Iran been referred to by America as a country that has challenged the international community's appeal

in terms of building nuclear projects).

c. Sign-Vehicle Analysis, namely the procedure for understanding text by counting the frequency of the number of times, for example, the word Indonesia appeared in Obama's remarks during a visit to Indonesia.

3. Research methods

This research was conducted in four stages, namely the preliminary stage, data collection, data processing, analysis and finally the Conclusion and Suggestion Stage. Shown in the flow chart as follows.

The preliminary stage consists of problem identification, research objective setting, literature study, field study. At the data collection stage, namely data that supports the data processing process.

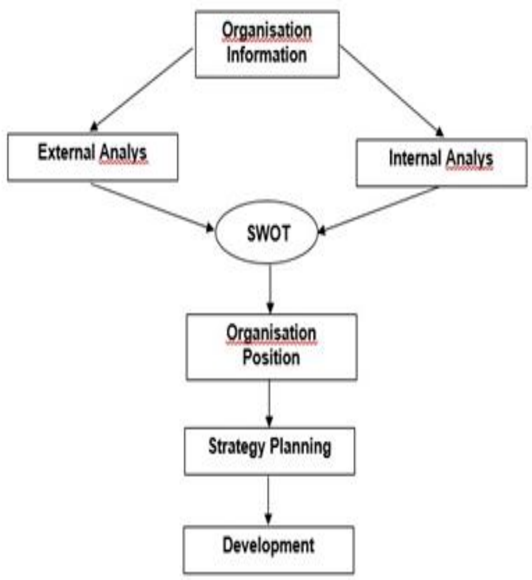

Figure 4. Flow Chart of Though

The preliminary stage consists of problem identification, research objective setting, literature study, field study. At the data collection stage, namely data that supports the data processing process. At the data processing stage, the steps for calculating the matrix are carried out by giving weight and rating values first. In the Analysis Phase, an analysis is carried out from the results of the calculations that have been contained in the quadrant which will later be used as an option for strategies and efforts to resolve these problems. At the conclusion stage, conclusions are drawn from the research that has been carried out as well as suggestions for further research that are related to this research.

4. Results and Discussion

Strategies, which are derived from policies, can be formulated to provide certainty or ensure that all existing problems can be answered by considering opportunities and threats as well as using the strengths and weaknesses of logistical support. has been identified in the discussion of the current conditions by paying attention to the indicators of success. SWOT analysis is used to identify the strategy to be formulated. These factors will be used as a calculation of weight, rating and score which can be described as follows:

a. Determine the strengths and weaknesses as internal factors.

1) Strength Factor (Strength).

The factors that can be a strength in supporting the task of the Indonesian Navy to increase its capability in implementing logistical support at Pangkalan are as follows:

a) Professionalism of soldiers sufficient

b) The spirit of the warrior high enough

c) The Indonesian Navy's policy of prioritizing the development of the foremost island base forces is of strategic value.

2) Weakness factor

The weakness factors that can inhibit the strength factor are as follows:

a) Human recources unlimited.

b) The base facility has not standard.

c) Limited infrastructure.

b) Determine the opportunity and constraint factor as an external factor.

3) Opportunity Factor

In determining the strategy, it is inseparable from the opportunity factor, which later can be beneficial for the strategy to be taken, as for the things that can be used as opportunities are as follows:

a) The strategic position of the island area which is occupied by the base

b) Government Policy on the World Maritime Axis

c) Government support in the program to accelerate development on islands which are occupied by bases

4) Threat factor.

a) Conflict Disputes still exist state maritime border country region.

b) Inclined marine weather extreme.

c) There is a threat of action crime at sea.

The next step is to carry out weighting on internal factors and external factors, the weighted value is obtained by taking data with experts in the Indonesian Navy in the role of diplomacy. The results of weighting the SWOT factor are as follows:

Table 1. Intern Factors

Strengs	weight	rating	Weightx Rating
Soldier professionalism	0.13	2	0,26
High morale soldi	0.12	3	0,36
Indonesian Navy policy regarding priority development of strategic island base forces	0.20	2	0,40
			1,02

Weakness	weight	rating	Weight x Rating
Human resources of soldiers are limited	0.30	4	120
base facilities are not standard	0.13	4	0,52
limited infrastructure	0,12	3	0,36
			2,08

Table 2. Ekxtern Table

Oportunities	weight	rating	Weight x Rating
Outer islands strategic position	0.30	3	090
Government policy on the world's maritime axis	0.17	3	0,34
Government support for the development of the outer islands	0,20	3	0,60
			`,84

Threats	weight	rating	Weight x Rating
border conflicts with other countries	0.16	2	0.32
extreme weather	0.17	2	0,34
threat of crime at sea	0,15	3	0,45
total	1;00		1.11

Table 3. Calculating faktor

Intern (X)	score	Ekstern (Y)	score
Strength	1.02	Opportunity	1.84
Weakness	1.20	Threat	1.11
difference	-0,18	difference	0,73

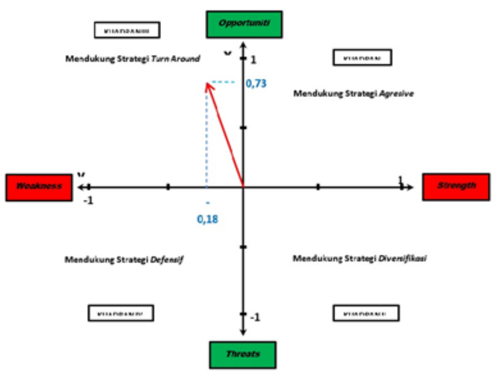

Figure 5. Quadrant Calculation Table

Based on the results of the calculation table and the SWOT quadrant image above, it can be seen that the right strategy is in quadrant III, (a combination of weakness-opportunity (W-O) which means it supports the Turn-Arround strategy, which means using available opportunities to turn weaknesses into advantages.

Table 3. Explanation Table

IFAS / EFAS	**Strengs (S)**	**Weakness(W)**
	1.Soldier professionalism 2.High morale soldier 3.Indonesian Navy policy regarding priority development of strategic island base forces	1.Human resources of soldiers are limited 2.base facilities are not standard 3.limited infrastructure
Oportunities(o) 1.outer islands strategic position 2.government policy on the world's maritime axis 2.government support for the development of the outer islands	**strategi SO** Combination of strategies: *S1O1,S1O2,S1O3 *S2O1S2O2,S2O3 *S3O1,S3O2,S3O3	**Strategi WO** Combination of strategies *W1O1,W1O2.W1O3 *W2O1,W2O2,W2O3 *W3O1,W3O2,W3O3

Table 4. SWOT Quadrant Combination

Threats (T)	Strategi (ST)	Strategi (WT)
1.border conflicts with other countries 2.extreme weather 3.threat of crime at sea	Combination of strategies: *S1T1;S1T2;S1T3 *S2T1,S2T2,S2T3 *S3T1,S3T2,S3T3	Combination of strategies: *W1T1,W1T2,W1T3 *W2T1.W2T1,W1T3 *W3T1,W3T2,W3T3

5) From data processing using SWOT, it can be concluded from the results of data processing, namely as follows:

a) The difference between strengths and weaknesses is -0.18 points.

b) The difference between opportunities and threats is 0.73 points.

c) From the results above, the SWOT position is in quadrant III, which means it supports the turnaround / investment investment strategy.

No	Strategy Formulation	Weight X Rating		Total	Rank
1	W-01	120		0.90	1
2	W-02	120	0.34	0.41	
3	W-03	120	0,60	0,72	2
5	W-01	0,52	0.90	0,47	3
6	W-02	0,52	0.34	0,18	
7	W-03	0,52	0.60	0,31	
9	W-01	0,36	0,90	0,32	
10	W-02	0,36	0,34	0,12	
11	W-03	0,36	0.60	0,22	

In order to optimize the capability of logistical support to support the duties of the Navy, an appropriate strategy is needed by taking into account the factors that influence it so that it can achieve the expected conditions. The following are several strategies that need to be formulated based on predetermined policy directions in order to optimize the capability of the Naval bases function :

a. Strategy - 1.

Carrying out maintenance and repair functions to support the maintenance of KRI and other defense equipment elements in accordance with the standard of base functions to support TNI / TNI AL operations.

b. Strategy - 2.

Carry out increased base functions in terms of maintenance through coordination and cooperation with the Government to build Pangkalan maintenance facilities

c. Strategy - 3.

Improving anchoring facilities through the construction of independent mooring facilities and pontoon wharves to ensure speed in providing logistical support for elements of the Navy operations that will carry out refilling.

In order to realize these policies and strategies in order to face the existing opportunities and constraints, concrete efforts are needed, including:

a. Strategic Efforts 1.

1) Realizing the availability of spare parts for elements of the Indonesian Navy operations, including KRI, submarines, aircraft and marine combat vehicles by building an integrated warehousing facility as a sub-depot for supplies on Island B.

2) Determine the basis for determining needs including material strength in accordance with provisions along with reserves, norm or stock index, number of days of provisions in accordance with operating needs.

3) In this case Disbekal cooperates with related agencies, namely PT. Pertamina in ensuring the availability of fuel and lubricating oil which is needed at any time, especially types of

special lubricants or those that are difficult to obtain and also for the possibility of easy distribution so that they can be directly pushed to areas that can later be stored in the warehouse of the Sub Depo of Supplies on the island of B.

4) Build Ammunition and Weapons Warehouse in support of defense equipment.

5) Cooperation with local governments to increase the need for supplies in the form of fresh water and foodstuffs to support defense equipment.

6) Increasing the quality and quantity of transportation facilities in sending supplies to operational elements.

b. Strategy efforts 2.

1) Build a docking facility for KRI repairs to carry out maintenance of the underwater stomach.

2) Build a machining workshop which is supported by complete and modern equipment.

3) Building an electrical repair shop.

4) Build a navigation and communication equipment workshop.

5) Providing technicians who have expertise in fixing elements from the top overhoul to general overhoul levels.

6) Cooperation with available shipyards around the archipelago.

c. Strategic Efforts 3.

1) Build an independent dock berthing facility with specifications that can accommodate large tonnage Indonesian Navy ships.

2) Build a pontoon dock to dock the submarine.

3) In cooperation with the local government to get priority to use the existing public jetty around Island B, if the jetty construction cannot yet be carried out.

4) Build warehouse building facilities to speed up the logistics distribution process that has been approved.

5) Providing complete infrastructure and facilities to support anchoring facilities.

6) Build buildings for generators as a substitute for ship electricity so as to save users of ship generator engines.

5. Conclusion

a. Integrated base logistics support in the field of supplies, especially the need for spare parts, can be optimized by building integrated infrastructure on Island B. As for liquid logistics, the collaboration with Pertamina is to be able to provide sufficient amount of fuel to support the TNI AL operations unit.

b. Logistic support in the field of maintenance and repair of all defense equipment can be optimized by building workshop facilities supported by reliable mechanics.

c. Logistic support in the field of anchoring facilities can be optimized for onwater boat jetty and pontoon jetty for submarines complete with infrastructure.

d. Logistical support in the field of personnel care can be optimized by optimizing existing hospitals and medical personnel.

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DETERMINATION TIME INTERVAL REPLACEMENT OF CRITICAL COMPONENTS IN SPERRY MARINE BRIDGEMASTER "E" RADAR SATUAN KAPAL CEPAT KOARMADA II

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ABSTRACT

One aspect of KRI operation readiness is navigation equipment. The navigation radar as a system for detection and location of objects has a vital function so that high radar readiness is needed to support operations. Scheduled maintenance management is required to fix or prevent system damage. The critical components of the Sperry Marine Bridgemaster E Radar were determined using the FMECA and reliability models in this analysis. Risk Priority Number obtain based on data from the expert questionnaire results in Sperry Marine Bridgemaster E Radar Maintenance. The Risk Matrix is used to analyze the RPN value of each component. Of the 20 (twenty) components found, 7 (seven) are considered critical. It is a DC motor drive, Interface Unit, Magnetron, Modulator, Power Supply Scanner, Electronic Processor Belt, and Drive Belt. According to the calculations, the Drive belt has a value of 43776, making it the lowest RPN, while the Electronic Processor has a value of 51840, making it the highest RPN. The modulator has the shortest replacement period of 128 days, while the Processor Electronic Unit has the longest replacement time of 271 days.

Keyword: FMECA, Time Interval of Replacement, *Risk Priority Number*, *Reliability.*

1. INTRODUCTION

KRI is a central power that must always be present at sea as the protector of the country's sovereignty. The large area of water that must be protected presents a challenge for KRI in terms of being as present at sea as possible to protect the marine environment. Therefore, the operational readiness of KRI is needed in carrying out these tasks.

Satkatkoarmada II is Commander for Development which has the main task to strengthen the combat capabilities, namely anti-surface ship warfare and anti-air warfare. The navigation radar used by the KRI Satkatkoarmada II is shown in Table 1.1. A good navigation system is one of the components of KRI readiness, and radar is one of the navigation systems. Radar is a vital role and has a long operating time. It has determined the object's location so that the KRI can navigate safely. A proper maintenance system is needed to maintain conditions so that the radar is in high readiness. The Sperry Marine Bridge Master E Radar has been used by KRI in Satkatkoarmada II, mounted on KRI KRS-624 and KRI AJK-653, which is about 13 years old and has over 16,000 operational hours, requiring more regular inspection of technical conditions.

Herry (2015) suggests the Fuzzy and TOPSIS methods for FMEA on the Sperry Marine Navigation Radar system in evaluating critical components and corrective maintenance but does not account for the period for removing critical components. Component damage distribution model, qualitative analysis with FMECA, and reliability analysis used in this research planning. At this time, if there is damage to the equipment/components, especially the navigation radar, it must wait for repairs, which takes a long time, while the ship has performed operational duties. This situation would make it difficult for KRI to perform operational duties. The purpose of this paper is to establish the mode of component damage so that it can take measures to avoid damage. Anticipate the need for replacement parts for equipment and components that are often damaged can be prepared. Since replacement parts are available, broken components can be repaired quickly, ensuring that KRI readiness to complete the assignment.

Table 1.1 Use of Navigation Radar in Satkatkoarmada II

No	Nama KRI	Radar Navigasi			
		Radar I		Radar II	
		Merk/Type	Usia (Th)	Merk/Type	Usia (Th)
1	KRI Mandau-621	Sperry Marine V Master	11	JRC JMA 5322	7
2	KRI Badik-623	JRC JMA 9225	6	JRC JMA 5320	17
3	KRI Keris-624	Sperry Marine B Master E	13	Sperry Marine V Master	5
4	KRI Sampari-628	Sperry Marine V Master	7	Sperry Marine V Master	7
5	KRI Tombak-629	Sperry Marine V Master	7	Sperry Marine V Master	7
6	KRI Hiu-634	Sperry Marine V Master	11	JRC JMA 5322	9
7	KRI Layang-635	JRC JMA 5312	15	JRC JMA 5320	12
8	KRI Terapang-648	Sperry Marine V Master	7	Furuno M-1935	7
9	KRI Singa-651	Raytheon Anschutz	2	Raytheon Anschutz	2
10	KRI Ajak-653	Sperry Marine B Master E	14	JRC JMR 9225	5

(Source : Satkatkoarmada II, 2021)

2. MATERIALS DAN METHODS

2.1 Radio Detection and Ranging (RADAR)

According to Bole et al. (2005), radar has a function to detect and calculate range target by radio. According to Skolnik (1962), radar is an electromagnetic system to detects and locates objects that reflect electromagnetic waves emitted by the system. Objects can be in the form of aircraft, ships, spacecraft, motorized vehicles, humans, or the surrounding environment.

Electromagnetic waves from the radar are emitted in all directions, and if they hit the object, waves are reflected. Where optical and infrared sensor equipment has limitations, radar can operate at long and short distances. Radar's ability to accurately calculate the distance between objects and work under all weather conditions is a vital role of radar. The radar can operate in low light, foggy conditions, rain, and snow.

The target detection process begins with the radar emitting electromagnetic waves through the antenna and emitted in all directions. If it hits the object, it will be reflected to be processed in the receiver then the results will be displayed on the radar screen. The process of locating an object can be obtained by connecting the antenna system with a gyro that shows true north. In addition, by analyzing the signal reflected by the echo/object reflector, its type can be determined. Although the signal received by a radar antenna is small, radio signals can easily be detected and enlarged. Meanwhile, the distance of the object can be determined from the calculation of the transmit and receive echo waves. Figure 2.1 shows the working principle of radar.

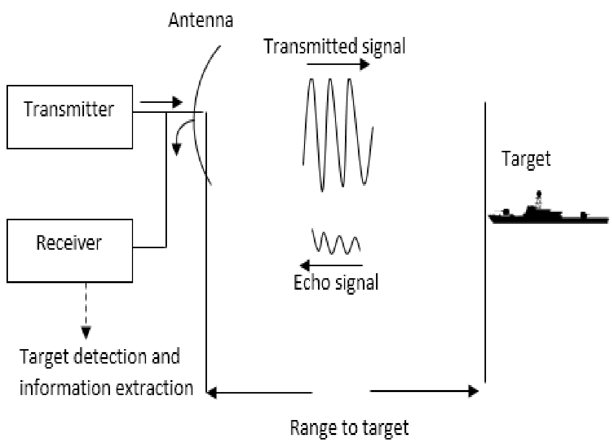

Fig 2.1 Radar Basic Principle (Skolnik,1962)

2.2 Qualitative Analysis Using FMECA

In certain cases, data to evaluate reliability quantitatively is insufficient, necessitating the use of another method to analyze reliability data qualitatively and based on experience. A system failure analysis is a qualitative analysis used to assess a system's reliability.

FMECA is a tool for testing a system with different failure modes from its components and then assessing the impact on the system's reliability. Analysis results are used (passive voice misuse) to scheduled system maintenance to avoid or minimize the risk of system failure.

According to Rausand (2004), the definition of FMECA is a methodology for :

Defining and analyzing

a. types of possible failure modes of a subsystem.
b. Defining and analyzing failure impact to the system.
c. Defining and analyzing reducing the effects of failure, especially to avoid disappointment in the system.

In determining the critical component, it is taken from the results of the experts' questionnaire on the severity rating, occurrence rating, and detection rating. Severity (S) is a factor that shows how serious the impact of damage is to the next process. Occurrence (O) is a factor that shows how often failure occurs in a certain period. Detection (D) is a factor that indicates how well a functioning control system can detect failures in the system's operation.

2.3 Risk Matrix Analysis

In determining the critical component of radar, after obtaining the RPN value, it is followed by a risk matrix analysis. The risk matrix classifies the components based on the consequences severity and frequency severity. Consequences severity sees the level of effect of component damage to the system, while frequency severity is seeing the number of times the component failure occurs in a certain period.

In the risk matrix analysis, not all components with high RPN are immediately categorized as critical components, but they have a greater chance to become critical components. In this analysis will be seen the level of frequency and the effect of damage to the system. So in a risk matrix analysis, components that have damage effect in the "critical" category are not necessarily in the "high" category. Likewise, components that have a frequent failure in the "frequent" category are not necessarily in the "high" category. Components with the "high" category in the risk matrix analysis have a higher impact and frequency of damage than other components. So these components fall into the category of critical components.

Table 2.1 Risk Matrix

Likelihood	Severity			
	Minor	Marginal	Critical	Catastrophic
Frequent	Accept	Medium	High	High
Probable	Accept	Medium	High	High
Occasional	Accept	Accept	Medium	High
Remote	Accept	Accept	Accept	Medium
Improbable	Accept	Accept	Accept	Medium

(Source: Anthony, 2009)

2.4 Weibull Distribution

The first step in calculating an equipment's or component's reliability is to understand the probability model of equipment damage data. The probability distribution was varying to reflect the most appropriate distribution for the data on equipment failure. The use of a suitable distribution model is required to make a detailed analysis. Damage data from the evaluated failure mode can be used to assess the damage model.

The Weibull distribution is often used to assess a component's reliability, especially for calculating component life. This is a flexible distribution because it can transform into another distribution by changing the scale and shape parameters. Parameters in the distribution allow the flexibility to model systems where the number of failures increases with time, decreases with time or remains constant.

According to Jardine and Tsang (2013), if the value of the location parameter in the three parameters Weibull distribution is equal to 0, it will be a two-parameter Weibull distribution. The Probability density function of the three parameters Weibull distribution is :

$$f(t)=\frac{\beta}{\eta}\left(\frac{t-\gamma}{\eta}\right)^{\beta-1}e^{-\left(\frac{t-\gamma}{\eta}\right)^{\beta}} \quad (1)$$

where ή is the scale parameter (also known as the characteristic life), β is the shape parameter, γ is the location parameter, and ή and β are positive.

The reliability function/$R(t)$ equivalent to 1 – $F(t)$, where F(t) is Cumulative Distribution Function. R(t) for Weibull distribution expressed by :

$$R(t) = e^{-\left(\frac{t-\gamma}{\eta}\right)^{\beta}} \quad (2)$$

The failure rate can be expressed by :

$$\lambda(t) = \frac{\beta}{\eta}\left(\frac{t-\gamma}{\eta}\right)^{\beta-1} \quad (3)$$

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2.5 Methodology

The analysis was carried out in stages to achieve the desired results. The flow chart for this analysis is shown in Figure 2.2.

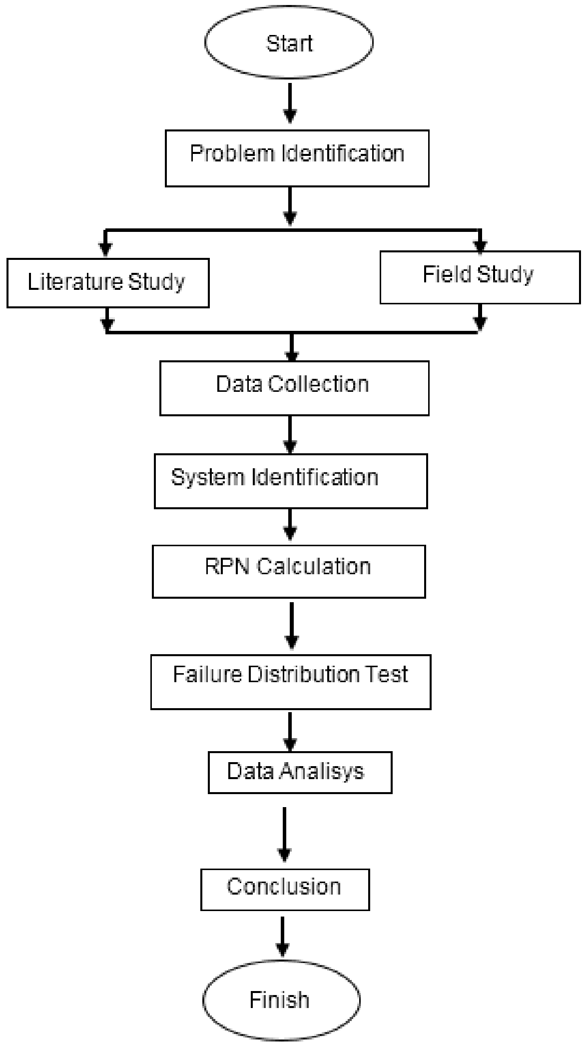

Fig 2.2 Research Flow Chart

3. RESULT AND DISCUSSION

3.1 Questionnaire Results of FMECA

The authors created a questionnaire with FMECA terminology and sent it to experts in the Sperrymarine Bridgemaster E Navigation Radar maintenance/repair system to collect data on the possibility of component failure mode. The Head of Fasharkan Lantamal V Electronics Workshop, Kasubdishar Sewaco Disharkap Koarmada II, Kasihar Sewaco Satkatkoarmada II, Head Department of Electronics KRI AJK-653, and Technician of PT Jala Purangga Sena became an expert in this questionnaire.

The RPN value is calculated by multiplying the severity rating, occurrence rating, and detection rating provided by the expert. The RPN value has been used as the base for determining the critical component candidates.

Table 3.1 Risk Priority Number

No	Components	RPN	Ranking
1	DC Motor Drive	51840	1
2	Interface Unit	50540	2
3	Magnetron	49096	3
4	Modulator	46620	4
5	Power Supply Scanner	44100	5
6	Processor Electronic Unit	44064	6
7	Scanner Control Unit	43956	7
8	Drive Belt	43776	8
9	GPS Antena	42840	9
10	Gyrosphere	41580	10
11	Memory Card	40460	11
12	Ups	39168	12
13	Tracker Ball	38080	13
14	Joystick	36960	14
15	Brilliance Control	35840	15
16	Keyboard	35805	16
17	PEU Fan	34782	17
18	CRT Monitor Fan	33660	18
19	Memory Card Battery	32116	19
20	Stavolt	31080	20

3.2 Determination of Critical Components

Each component is analyzed in terms of the severity of consequence and severity of frequency and then processed into a risk matrix based on the criteria. The risk rating components "high" has a higher average frequency of occurrence and severity of damage when compared to components with a rating of risk "acceptable" and "moderate". The analysis for each component of the risk matrix is shown in Table 3.2.

Table 3.2 Components Rating Risk

No	Components	*Risk Rating*
1	DC Motor Drive	High
2	Interface Unit	High
3	Magnetron	High
4	Modulator	High
5	Power Supply Scanner	High
6	Processor Electronic Unit	High
7	Scanner Control Unit	Medium
8	Drive Belt	High
9	GPS Antena	Accept
10	Gyrosphere	Accept
11	Memory Card	Accept
12	Ups	Accept
13	Tracker Ball	Accept
14	Joystick	Accept
15	Brilliance Control	Accept
16	Keyboard	Accept
17	PEU Fan	Accept
18	CRT Monitor Fan	Accept
19	Memory Card Battery	Accept
20	Stavolt	Accept

Table 3.3 shows a list of critical components that have high RPN and risk obtained from the 20 components.

Table 3.3 Critical Components

No	Components	Category	Frequency	Risk Matrix	RPN
1	DC Motor Drive	*Catastrophic*	*Frequent*	High	51840
2	Interface Unit	*Catastrophic*	*Occasional*	High	50540
3	Magnetron	*Catastrophic*	*Frequent*	High	49096
4	Modulator	*Critical*	*Occasional*	High	46620
5	Power Supply Scanner	*Critical*	*Probable*	High	44100
6	Processor Electronic Unit	*Critical*	*Probable*	High	44064
7	Drive Belt	*Catastrophic*	*Frequent*	High	43776

3.3 Analysis of Reliability Before Time Interval Replacement

Before the calculation replacement, the reliability value must be known in advance such that the time interval for the replacement can be determined to obtain the desired reliability value. Processing data use Reliasoft"s Weibull ++.

Table 3.4 Components Reliability Value before Replacement

No	Components	MTBF (Day)	*Reliability*
1	DC Motor Drive	267	0,5405
2	Interface Unit	271	0,5007
3	Magnetron	163	0,5029
4	Modulator	138	0,5325
5	Power Supply Scanner	169	0,5225
6	Processor Electronic Unit	264	0,4786
7	Drive Belt	212	0,4360

According to the calculations in table 3.4, the DC motor drive has the highest reliability value, 0.5405, while Drive Belt has the lowest reliability value, 0.4360. The replacement period must be determined based on the components reliability data above to increase components reliability as desired.

3.4 Analysis of Reliability After Time Interval Replacement

To achieve the optimal minimum reliability value, the replacement time interval is determined by entering the variation of the replacement time interval. The modulator has the shortest replacement time, which is 128 days, while The Processor electronic Unit has the longest replacement time, which is 258 days.

Table 3.5 Components Reliability Value after replacement

No	Components	MTBF (Day)	Time Interval Replacement (Day)	*Reliability*
1	DC Motor Drive	267	224	0,95144
2	Interface Unit	271	232	0,95746
3	Magnetron	163	155	0,96480
4	Modulator	138	128	0,95037
5	Power Supply Scanner	169	162	0,97103
6	Processor Electronic Unit	264	258	0,95513
7	Drive Belt	212	205	0,95718

4. CONCLUSION

The following results can be drawn from the analysis and discussion that has done in the previous chapter :

a. Calculation of Risk Priority Number and Risk Matrix analysis using the FMECA method on the Radar Sperry Marine Bridge Master E, from the twenty components analyzed, seven critical components are obtained DC motor drive, Interface Unit, Magnetron, Modulator, Power Supply Scanner, Processor Electronic Unit, and Drive Belt.

b. Based on the calculations, the modulator has the shortest component replacement period of 128 days, while Processor Electronic Unit has the longest replacement time of 258 days.

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PATROL SHIP SELECTION ANALYSIS TO SUPPORT MARITIME SECURITY OPERATIONS IN THE WORKING AREA OF LANTAMAL V SURABAYA

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ABSTRACT

In order to maintain maritime security, especially in the Lantamal V Surabaya working area, the patrol ship unit elements must be ready to deal with all incidents with quick responses. Therefore, it is very necessary to have the most precise patrol ship specifications to carry out tasks that are faced with frequent vulnerabilities, and are also faced with a limited state defense budget. This research proposes the use of the integration of the Fuzzy MCDM and BCA methods in selecting the type of Satrol ship. The Fuzzy MCDM method is considered very appropriate for the problem of fuzzy criteria weights. The BCA method is used to analyze the benefits and costs that will occur as a consequence of the operation of the ship. Based on this research, it is concluded that from the available alternatives, the best Patrol ship that should have been selected for the development/ procurement of Satrol ship is "C" Class ship with a value of 0.6073 using the Fuzzy MCDM method and 1.03 using the BCA method. The results of this research are expected to be input and considerations for the leadership of the Indonesian Navy in the development of future Satrol ships.

Keywords : *Satrol ships, Lantamal V, Fuzzy MCDM, BCA*

1. INTRODUCTION

The 1945 Constitution states that the Government is obliged to carry out state defense efforts from all forms of threats, especially military threats originating from foreign countries. One of the national defense forces possessed by the Indonesian nation is the Indonesian Navy which has the main duties listed in the TNI Law No. 34 of 2004, as the enforcer of state sovereignty at sea. In carrying out the duties of the Indonesian Navy, it is determined by the components of the force which include personnel, defense equipment and methods. One of the defense equipment that determines the readiness of the Indonesian Navy in maintaining the integrity of the Republic of Indonesia is a ship.

The KRI elements in the Indonesian Navy are grouped into 7 ship units :Satkor (Excorta ship unit), Satsel (submarine unit), Satfib (amphibious ship unit), Satkat (fast boat unit), Satran (mine ship unit), (Auxiliary ship unit). Which in each ship unit has different roles and functions according to the condition of the waters (state of sea) and the types of violations and crimes that have occurred. The types of threats, violations and crimes that most often occur in Indonesian waters are illegal fishing, illegal logging, human trafficking, ship piracy, smuggling of weapons and violations of territorial borders by other countries. This requires the readiness of our KRI elements. This is inversely proportional to the readiness of the elements the existing KRI elements, in which the number and technical conditions are not supportive of the implementation of these tasks, so it is necessary to procure KRI system equipment to deal with all forms of threats and violations in order to uphold the sovereignty and maintain the integrity of the Republic of Indonesia with all the risks it faces. Procurement of Indonesian Navy defense equipment refers to the national defense policy set by the Ministry of Defense, and is bound to the Minimum Essential Force (MEF) as stipulated in Perkasal No. 5 of 2016 dated 26 April 2016 concerning Basic

Policies for the Development of the Indonesian Navy towards the Minimum Main Strength (MEF). Referring to the MEF in the procurement of defense equipment, in particular the patrol ships (Satrol Class) which will be procured 46 units of KRI Satrol until 2024, this research will select the type of Satrol ship that is most suitable for Indonesian territorial waters faced with types of threats, violations and crimes that often occur. The current condition of the patrol boat (Satrol) Lantamal V Surabaya only has 3 (three) ships namely KRI Salawaku, KAL Warakas and KAL Krait.

With the demands of a large security area, when compared to the strength of the existing elements, it is very necessary to add suitable ships to be assigned to The Lantamal V Satrol. Therefore a comprehensive comparative analysis is required of the best / representative patrol boat alternative for the Lantamal V working area.With the large number of offers and types of Satrol ships, priorities will be determined in using the type of ship based on the role and main function of the patrol boat in front of the the geographical conditions of Indonesian waters which consist of thousands of islands and shallow straits and fast currents. The main role and function of the KRI Satrol apart from maintaining the sovereignty of the NKRI territory is routine patrols limited to Indonesian territorial waters, especially in narrow and shallow water areas / straits, so a patrol boat that has the ability to accelerate speed and high maneuverability is needed as well as a draft that is needed. low.

In carrying out the analysis of the selection of the type of patrol boat, it requires analysis of information and identification of various requirements, including operational requirements (Opsreq.) And technical requirements (Techreq.), Including of course the cost of the KRI procurement contract. Given the budget constraints due to the current Covid 19 pandemic, in choosing the KRI procurement, in addition to considering the two requirements, namely operational and technical, it is necessary to also analyze the criteria that affect the procurement of this defense equipment. So that in this thesis research will use the integration of the methods of Fuzzy Multi Criteria Decision Making (Fuzzy MCDM) and BCA (Benefit Cost Analysis).

In several studies it was stated that, MCDM is a method that refers to the process of screening, prioritizing, ranking, or choosing a set of alternatives. MCDM is very appropriate to be implemented in multi-criteria cases where all alternatives have the criteria weight in nominal form. The BCA method is used to analyze the benefits and costs that will occur as a consequence of the operation of the ship from the calculation results through Fuzzy MCDM. The expected result from this research is the best alternative type of patrol boat for the work area of Lantamal V Surabaya waters which is not only good in meeting the criteria required by the Indonesian Navy, but also efficient and economical in terms of costs.

2. LITERATURE REVIEW

2.1 Main Duties**.** The main task of the Satrol (Patrol Boat Unit) is to carry out patrols in the areas closest to the coastline or channel which are narrow and quite shallow.

2.2 Operational Requirements for Patrol Boats (Opsreq)

Based on the basic policy of building the Indonesian Navy's strength, as a first step in the procurement of the TNI AL's defense equipment, it is necessary to establish a Wantuada (Procurement Determination Board), in which the procurement of patrol-type vessels needs to be made Operational Requirements which are oriented towards the following matters (Mabesal, 2015):

- Security. The security and safety of the KRI ABK is the main thing that is needed in all types of warships, including patrol unit ships.
- Speed

Speed is a very important part needed by this type of patrol unit ship, because in addition to the main task of fighting, it is also to maintain the security of Indonesia's seas, which consist of archipelagic areas with fast currents and narrow and shallow straits.

- Transfer of Technology (TOT)

The procurement of KRI must consider the Transfer of Technology process, so that in the future the Indonesian people, especially the Indonesian Navy, can manufacture, operate and maintain independently. In addition, the platform and rigging technology level allows it to be upgraded according to technological developments.

- Armament

The patrol unit ship must be able to be armed with a cannon, as a weapon in stopping crime or security disturbances at sea or capable of being provided with more modern weapons.

2.3 Patrol Boat Technical Requirements (Techreq)

Technical requirements are a requirement in the procurement of a KRI which was previously carried out by a team of experts from the Indonesian Navy Headquarters in the field of Platform and Sewaco (Sensor, Weapons and Control) serving in the Navy Procurement Service (Disadal), Navy Material Service (Dismatal) , Naval Airworthiness Service (Dislaikmatal) and Naval Armament and Electronics Service (Dissenlekal). The technical requirements consist of 5 (five) main points, namely Navigation, Platform, Sewaco, Engineering and Electricity (Mabesal, 2015).

2.4 Concept Theory Fuzzy

The concept of this fuzzy theory was initiated by Lutfi A. Zadeh in 1965 with his seminary paper "Fuzzy Sets" (Zadeh, 1965). With this fuzzy theory, it shows that all theories can be used as a basic concept rather than fuzzy / continues membership function. In general, this fuzzy theory can be classified into five main areas, namely:

- *Fuzzy Mathematics*, where the concept of classical mathematics is extended by converting classical sets into fuzzy sets;
- *Fuzzy Logic & Artificial Intelligence*, where estimates for classical logic are introduced as well as expert systems are developed based on fuzzy information / thought forecasts;
- *Fuzzy System*, which includes fuzzy control through a fuzzy approach with process and communication signals;
- *Uncertainty and Information*, where the differences in the uncertainties are analyzed;
- *Fuzzy Decision Making*, where the consideration for optimization problems exists.

2.5 Membership Functions

The membership function is a curve that shows the mapping of data input points into their membership values (often referred to as membership degrees) which have intervals from 0 to 1. One way that can be used to obtain membership values is through the approach. function. There are several functions that can be used:

a. Linear Representation

In a linear representation, the mapping of the input to the degree of membership can be drawn as a straight line. This form is the simplest and also the right choice to approach an unclear concept. There are 2 states of linear fuzzy set, first is the set increment, starting at the value of the domain which has zero degree of membership [0] shifting to the right to the value of the domain which has a higher degree of membership.

Membership Functions:

$$\mu[x] = \begin{cases} 0; & x \le a \\ (x-a)/(b-a); & a \le x \le b \\ 1; & x \ge b \end{cases} \quad (1)$$

Second, it is the opposite of the first. The straight line starts from the value of the domain that has the highest degree of membership on the left side, then moves down to the value of the domain that has the lower membership.

Membership Functions:

$$\mu[x] = \begin{cases} (b-x)/(b-a); & a \le x \le b \\ 0; & x \ge b \end{cases} \quad (2)$$

b. Triangle Curve Representation

A triangle curve is basically a combination of 2 (linear) lines.

Membership function:

$$\mu[x] = \begin{cases} 0; & x \le a \text{ atau } x \ge c \\ (x-a)/(b-a); & a \le x \le b \\ (c-x)/(c-b); & b \le x \le c \end{cases} \quad (3)$$

c. Trapezoid Curve Representation

The trapezoid curve is basically like a triangle shape, except that there are points that have a membership value of 1.

Membership function:

$$\mu[x] = \begin{cases} 0; & x \le a \text{ or } x \ge d \\ (xa)/(ba); & a \le x \le b \\ 1; & b \le x \le c \\ (dx)/(dc); & c \le x \le d \end{cases} \quad (4)$$

2.6 Triangular Fuzzy Number (TFN)

In TFN, every single value (crisp) has a membership function consisting of three values, each of which indicates the lower value, the middle value and the upper value.

A = (a1, a2, a3)

The membership functions for TFN in the image above are as follows:

$\mu[x] =$ = 0 for x <a1

$= \frac{x - a_1}{a_2 - a_1}$ for a_1 <x <a2 (5)

$= \frac{a_3 - x}{a_3 - a_2}$ for a_2 <x <a3

2.7 Value Defuzzification

Defuzzification is a process of converting and quantity from blurring into a definite quantity, where the output and fuzzy process can be a logical combination of two or more fuzzy membership functions defined according to the universe of discussion. Input and defuzzy process is a fuzzy set obtained from the composition of fuzzy rules, while a number in the domain of the fuzzy set is the resulting output. The defuzzification methods commonly used today are as follows:

a. Centroid Method (Center Of Gravity / COG) In this method, a crisp solution is obtained by taking the center point (z) of the fuzzy area.

b. Bisector Method In this method, the crisp solution is obtained by taking the value contained in the fuzzy domain which has a membership value half of the total membership value in the fuzzy area.

c. Mean of Maximum (MOM) method In this method, the crisp solution is obtained from taking the average value of the domain that has the maximum membership value.

d. Largest of Maximum (LUM) method In this method, the crisp solution is taken from the largest value from the domain that has the maximum membership value.

e. The Smallest of Maximum Method (SOM) In this method, the crisp solution is taken from the smallest value from the domain that has the maximum membership value.

2.8 Linguistic Variables

A linguistic variable is a variable that has a description in the form of a fuzzy number and is more generally a word represented by a fuzzy set. For example, descriptions of linguistic variables for temperature could be LOW, MEDIUM and HIGH for example where the descriptions are expressed as fuzzy values. (Tsoukalas, 1997). Like algebraic variables that use numbers as their values, while linguistic variables use words or sentences as their values to form a set which we call a set of "terms", each value of the "term" is a fuzzy variable defined based on the base variable. While the base variable itself defines the universe of speech for all fuzzy variables in the set of "terms" (Jantzen, 1998).

2.9 BCA (Benefit Cost Analysis)

Benefit Cost Analysis is a practical way of estimating project benefit, which requires a long and extensive review. In other words, it requires analysis and evaluation from various points of view that are relevant to the costs and benefits it contributes. B / C Analysis is usually done by looking at the ratio of the benefits of a project to the general public against the costs incurred. Mathematically this is formulated as follows:

$$BCR = \frac{\text{Nilai TPV pada Faktor } Benefit\ (B)}{1 - \text{Nilai TPV pada Faktor } Cost\ (C)} \quad (6)$$

A project is said to be feasible or can be implemented if the ratio of benefits to costs required is greater than one. The approach to using B / C Analysis in ANP is the same as the B / C Analysis approach in general, if the ANP comparison will be made is superiority priority and price priority, so that what will be chosen is the comparison value with the largest value.

3. DATA COLLECTION AND PROCESSING

This section will explain about data collection, which then the results will be processed to get the desired results.

3.1 Procurement of Patrol ship types

The procurement of a KRI is a special procurement because it includes defense equipment which has a secret nature and cannot be carried out by incompetent parties. The procurement process was not easy, involving many teams overseeing the process, from the negotiation and insurance supervisory team, the task force team, the feasibility team, the function test team or acceptance test, the inspection team to the receiving team.

In the Indonesian Navy, the procurement of a KRI is regulated in the Decree of the Chief of Naval Staff No. Kep / 1100 / VI / 2015, which is contained in the PUM-7,100 of the Indonesian Navy regarding the Guidebook for the Implementation of the Procurement Determination Board (Wantuada) of the Indonesian Navy's Alut and Alutsista. Therefore, in determining the KRI to be purchased, it must be based on the basic function of the KRI, it is faced with the task field at hand, so it is necessary to determine various appropriate criteria.

3.2 Data collection

Before processing data, it is necessary to first collect the required data. The data to be obtained based on the method of collection can be divided into primary data and secondary data. Primary data is obtained directly from resource persons who are experts in their fields and someone who is a decision maker by filling out questionnaires and face-to-face interviews. While secondary data is data obtained through literature studies both from documents and related reference books. The desired data includes various factors that influence the decision in choosing the type of patrol boat, including technical specifications, characteristics of the ship material used, operation and maintenance, the state of the country's economy.

3.3 Patrol Ship Type Selection Criteria

Criteria are measures, rules, and standards that are used by decision makers. Various factors are considered in the decision-making process for choosing which type of patrol boat to purchase in the future. At this stage, the determination of criteria is carried out preceded by conducting consultations with shipping experts. Consultation is carried out by means of discussion, either carried out with an expert or discussion with several experts in the fields of operations, technicians, maintenance, procurement and research and development offices.

The criteria developed are related to the factors that influence the decision to choose the type of patrol boat that will be considered for future development of the Satrol Boat. Taking into account the opinions of various sources both from the Navy shipping experts and their users as well as the existing literature, in this study the following criteria were developed. The criteria considered for selecting the right patrol boat at a base are divided into two parts, namely quantitative criteria and qualitative criteria.

3.3.1 Quantitative Criteria

Quantitative criteria are criteria that have a definite value, so that they can be compared between one choice and another. As for the quantitative criteria that are taken into consideration in the selection of this patrol boat are as follows:

a. Procurement and Operational Costs
b. Speed
c. Use age
d. Range / Mileage

3.3.2 Qualitative Criteria

Qualitative criteria are criteria that do not have a definite value, so to find out the value it is necessary to quantify the qualitative criteria and then obtain a numerical value from the qualitative criteria. As for the quantitative criteria that are used considerations in selecting weapons are as follows:

a. Reliability
b. Maintainability
   1) Field Maintenance
   2) Ease of Spare Parts
c. Complexity
   1) Safety Features
   2) TOT
   3) Service
d. Operation
   1) Ease of Use
   2) Operating Personnel
e. Tactical
   1) Navigation
   2) Platform
   3) Sewaco
   4) Machinery
   5) Electrical
f. Special
   1) Political
   2) Strategic

3.4 Alternative Patrol Ship

The alternative of selecting the type of patrol boat used in this study is a suitable type of Satrol Boat in Lantamal, which will be developed for the future. The types of patrol boats include:

a. “A” Class ships;
b. “B” Class ships; and
c. “C” Class ship.

3.5 Data processing and analysis

At this stage, data processing will be carried out on the data obtained in the previous sub-chapter. The aim is to obtain a more detailed description of the relationship between each criterion, alternative types of patrol boats and the general procurement process with the help of software in the calculation process.

3.5.1 Fuzzy MCDM processing method Analysis of the total aggregate weighting results

In the aggregate weighting process for data for each criterion and alternative, data processing is carried out with the aim of finding the lower, middle and upper values for each criterion and alternative.

The following is a recap of the criteria and alternative weights generated using the fuzzy MCDM calculation shown in Tables (4.1) and (4.2). The recap of weights shown in table (4.1) is only the middle value of each criterion and likewise the alternative weight values shown in the table are only the middle value.

Table 1. Recap of the Aggregate Weights of Qualitative Criteria

NO	QUALITATIVE CRITERIA		WEIGHT
1.	RELIABILITY		8,4
2.	MANTAINABILITY	MAINTENANCE	6.37
		EASY SUCAD	8,1567
3.	COMPLEXITY	SAFETY FEATRS	6,885
		TOT	6,7317
		SERVICE	6,0667
4.	OPERATION	EASY TO USE	6,5117
		PERSONNEL OPS	6,3583
5.	TACTICAL	NAVIGATION	9,3033
		PLATFORM	9,3033
		SEWACO	5,8383
		MACHINE	6.8067
		ELECTRICAL	6,6733
6.	SPECIAL	POLITICAL	5,9083
		STRATEGIC	6,7433

Table 2. Recap of Alternative Aggregate Weights

NO	CRITERIA	Mit	Weight
1.	Reliability	ALT 1	7,812
		ALT 2	7,765
		ALT 3	6.95
2.	Maintainability	ALT 1	6,623
		ALT 2	6,603
		ALT 3	7,812
3.	Complexity	ALT 1	6,072
		ALT 2	6,333
		ALT 3	9,072
4.	*Operation*	ALT 1	6,945
		ALT 2	8,038
		ALT 3	7,535
5.	Tactical	ALT 1	6,962
		ALT 2	7.49
		ALT 3	8,043
6.	Special	ALT 1	6,617
		ALT 2	7,475
		ALT 3	7.78

Tables (4.1) and (4.2) are the aggregate total weighting results where this weighting is useful for finding the fuzzy index and will be used as data input for the defuzzification process.

3.5.2 Analysis of the fuzzification and defuzzification processes

Defuzzification is a process to get a single value from the linguistic value. The best defuzzification method to use in fuzzy MCDM is the Center of Gravity (COG) method / Centroid method (Kainz, 2003). By paying attention to this research, in this research the researcher uses the Centroid method by taking the Crisp value (single value) that comes from the middle of the existing fuzzy area so that it is very precise with the design of the membership function and the basis of the fuzzy rules used.

Table 3. The index value forming the evaluation value

INDEX	ALTERNATIVE		
	1	2	3
Yi	20.81	22.37	25.95
Qi	47.87	49.76	54.86
Zi	74.13	76.16	80.93
Hi1	1,827	2,167	2,458
Ti1	6,014	5,318	5,106
Hi2	5,208	5,433	5,898
Ui1	2.68	2,595	2,286
Ti2	21.98	23.05	25.1
Ui2	-27.9	-28.2	-27

After knowing the index forming the evaluation value in table (4.4), then the process of searching for the value of the fuzzy membership function (fG (x)) and the fuzzy Gi index is carried out followed by processing it into a utility value so that it can be seen which alternative is the best. The following values for fGi (x) and Gi are shown in table (4.5).

Table 4. Value of fGi (x) and Gi

SCORE	Alt 1	Alt 2	Alt 3
Gi	45,100	47,172	51,961
FGI (x)	0834	0.895	0.988

After knowing the fuzzy index value, the next step is to find the utility value for each alternative based on qualitative criteria. By using the equation, the results of the utility value can be seen in the following table:

Table 5. Sti (Qualitative) Value for each Alternative

SCORE	Alt 1	Alt 2	Alt 3
Sti	0.230	0.247	0.272

Likewise for quantitative criteria, the utility value is also sought using the equation, it will get the utility value for the quantitative criteria which we can see in the table below:

Table 6. The OTi (Quantitative) Value of each Alternative

SCORE	Alt 1	Alt 2	Alt 3
OTi	0.234	0.247	0.281

From (Table 4.7) above it can be seen the utility value of each alternative. From the 3 alternatives, it can be seen that alternative 3 has the highest utility value, namely0.281 followed by alternative 2 of 0.247, and the last alternative 1, namely 0.234.

Finally, to get the total ranking value for each alternative, both qualitative and quantitative criteria, use the above equation so that the final result can be seen in table (4.8) below:

Table 7. Total score and final ranking of each Alternative

VALUE	Alt 1	Alt 2	Alt 3
FTi	0.232	0.347	0.421
RANK	III	II	I

3.5.3 Processing of the analysis method of Benefit Cost Analysis (BCA)

Another theory used by researchers in data processing in this study is Benefit Cost Analysis (BCA). The technique chosen for data processing using the BCA theory this time is the Benefit Cost Ratio (BCR) technique which will produce the BCR value. If the comparison result of BCR> 1 means that the project provides benefits if BCR <1, then on the other hand, the project is detrimental or does not provide benefits.

In this study, classify all the existing criteria in determining the types of elements of the Satrol Lantamal V, which amount to 19 sub-criteria, into two groups of factors, namely the Benefit factor and the Cost factor. Benefit factors are defined as all factors that can have a positive influence and good results on the selection of elements of Satrol Lantamal V. While the cost factor is anything that requires more cost, time and energy to fulfill it, so that it can support the operational elements of Satrol properly. The results of the weighting value of each alternative of the Benefit factor will be compared with the result of the Cost factor, so that the weight of the benefits or benefits of each of the available Satrol element alternatives will be known.

Table 8. Classification of Benefit and Cost Factors

NO	CRITERIA	GROUP
1	RELIABILITY	Benefits
2	PLEASE	Cost
3	EASY SUCAD	Cost
4	SAFETY FEATURES	Benefits
5	TOT	Benefits
6	SERVICE	Cost
7	EASY TO USE	Benefits
8	PERSONNEL OPERATING	Benefits
9	NAVIGATION	Benefits
10	PLATFORM	Benefits
11	SEWACO	Benefits
12	MACHINE	Benefits
13	ELECTRICAL	Benefits
14	POLITICAL	Cost
15	STRATEGIC	Cost
16	PROCUREMENT AND OPS	Cost
17	ENDURANCE	Cost
18	SPEED	Cost
19	AGE OF USE	Cost

The priority weight results show the overall priority of alternatives and existing criteria, both on the benefit and cost factors. In the end, the Total Priority Value (TPV) for the Cost Factor and Benefit Factor of each of the Surabaya Lantamal V Surabaya Satrol Vessels is as follows:

Table 9. The Priority Weighted Value of Benefit and Cost Factors

NO	TYPE OF SHIP	TOTAL PRIORITY VALUE	
		BENEFIT	COST
1	"A" Class	0.09685	0.11509
2	"B" Class	0.05577	0.06313
3	"C" Class	0.30658	0.28283

After entering into the BCR formula, it is obtained:

- BCR Value of Satrol "A" Class = 0.15
- BCR Value of Satrol "B" Class = 0.24
- BCR Value Satrol "C" Class = 1.03

The BCA calculation is obtained through the BCR technique which compares the TPV value of the results of grouping the criteria for selecting elements of Satrol Lantamal V Surabaya into the Benefit and Cost Factors. The results of the Satrol "C" Class element can provide benefits or benefits (BCR value 1.03). Meanwhile, other Satrol elements did not provide benefits / advantages (BCR value <1).

4. CONCLUSIONS

This chapter contains the conclusions from the results of the research that has been carried out and suggestions that can be given to the Indonesian Navy as well as for the development of further research. From the stages of data processing and analysis carried out in the previous chapter, the following conclusions can be drawn:

a. There are 6 (six) main criteria with 15 (fifteen) sub-criteria on the qualitative criteria and 4 (four) quantitative criteria used to determine the priority of the 3 (three) alternative Satrol ships to be operated in Lantamal V Surabaya.

b. Based on data processing with Fuzzy MCDM, the alternative was selected with the highest weight of "C" Class with a value of 0.421 and based on BCR analysis the selected "C" Class was also selected because based on the results of data processing it had the highest BCR value of 1.03 meaning it was the most profitable when choosing the ship. Thus, it can be used as a reference for the leadership of the Indonesian Navy in determining policies for selecting priority types of Satrol ships.

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SECURITY SIMULATION OF SEA TOLL TRACK BY KRI HEADQUARTER ELEMENTS CORRESPONDING SECTOR OF MARITIME SECURITY OPERATIONS EAST REGION

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ABSTRACT

The concept of Sea Toll which is a Pivot of World Maritime policy programs contributes to National equalization. Where the role of the pioneer ship in the region, especially East Java Province into one of the security programs. Related to maritime security, Lantamal V has the power KRI element to support security operations these pioneer ship lines. By using the Simulation method, model the security designed according to the behavior of an operating system of KRI and sea transport of pioneer ship, so that gives the picture and pattern operate for in the execution of decision making for strategic to head TNI AL in the plan operate for

Keyword: Pivot Maritime, Concept of Sea Toll, Simulation.

1. INTRODUCTION

The determination of maritime sector development priorities initiated by the Government of President Joko Widodo is very reasonable from the point of view of the nation's history. The main target for the development of the maritime sector is to make Indonesia a World Maritime Axis Country, where there are five pillars to make it happen, namely rebuilding maritime culture, managing marine resources, developing infrastructure and maritime connectivity, enhancing maritime diplomacy, and building maritime defense forces.

The concept of the sea highway, which is a strategy for developing infrastructure and maritime connectivity, is expected to realize an efficient and even distribution of goods throughout the country through sea transportation. To implement this strategy, the government has set several achievement targets including; strengthening shipping and port fleets, especially in eastern Indonesia, revitalizing five major ports to become hubs and logistic centers (Belawan, Tanjung Priok, Tanjung Perak, Makassar, and Sorong), modernizing port facilities and information systems, fully strengthening the cabotage principle by strengthening the shipyard industry national ships capable of meeting the growing demand for sea highway national ships.

In connection with the implementation of the sea highway, the conception of maritime defense is compiled to oversee every government policy in order to safeguard the sovereignty of the Unitary State of the Republic of Indonesia (NKRI) over maritime wealth, the safety of shipping, and security of the region and the nation as a whole as well as overcoming any incidents of violation of sovereignty and law at sea which has legal legality both nationally and internationally.

Basically, the operational pattern of securing pioneering ship routes by the Indonesian Navy has a very complex factor where each route will involve more than one defined operation sector in the Lantamal area. This will be very difficult if analyzed using a mathematical model. One of the methods used in various military analyzes that can accommodate the complexity of operating patterns is a simulation model. The simulation model that will be used in this research is the Arena simulation model because basically, this simulation is a simulation of the real world using the concept of probability. Where the concept of safeguarding the sea highway is stochastic, it can be approached using a simulation method. The simulation results obtained can then be used as input in developing a strategy for projecting the strength of the Indonesian Navy against government programs regarding the security of the maritime highway / pioneering route.

2. MATERIALS AND METHODS

Based on the mandate of the Republic of Indonesia Law number 34 of 2004 concerning the TNI, the Navy as an integral part of the TNI, apart from having the main task of enforcing sovereignty (article 7) also has to enforce the law and maintain maritime security from various forms of threats in the waters Indonesian national jurisdiction (art. 9). In order to carry out the mandate of this law, the Indonesian Navy has a perception that the sea must be safe from three aspects of threats which include both dimensions, both sovereignty, and law. The three aspects of the threat are threats of violence, threats of navigation hazards, and threats of law violations.

In this study, the simulation method is used because the simulation method can be used to solve quite complex problems by simplifying it so that it has the possibility to be applied to problems that occur in the operation of securing the Sea Highway. This is since in the implementation of security operations there are often uncertain conditions. For this reason, this study uses a system modeling approach using a simulation method that combines two aspects of decision-makers, namely qualitative aspects and quantitative aspects.

Simulation is one part of an operation research study (Operation Research) which includes problem definition, model development, model solving, testing the validity of the model, and implementing the final result. Simulation as a problem-solving analysis method has been widely used, starting from the results of research and then being published by members of the TIMS and ORSA (The Institute of Management Science and Operation Research of America). In general, simulation systems are widely used in the military world, both on a broad and narrow scale.

3. ANALYSIS AND DISCUSSION

3.1 System Description

Data collection in this research activity was carried out in the ranks of the Surabaya Navy Main Base (Lantamal V), Tanjung Perak Port Authority (OP), East Java Transportation Service (Dishub), and PT. Pelni Surabaya Branch.

3.2 Conceptualization of the Model

The model conceptualization stage is a series of system modeling activities using simulation. The stages of activity carried out are identifying variables that are thought to have a relationship with the system to be modeled.

3.3 Variable Identification

Decision variables are variables that affect the processes or activities of the system. This variable plays a role in determining the character of the input which will determine the form of the output produced after going through the process in the system.

The variables that affect response time KRI (Table 1) in securing the Sea Highway that pioneer ships pass is as follows:

1) The number of KRI on patrol

The number of KRIs on patrol is related to the sea highway traversed by pioneer ships.

2) The intensity of the anchor clock

The intensity of the anchor hour is related to the effectiveness of the KRI's ability to secure the maritime highway.

3) KRI speed

The speed of the KRI is related to the ship's ability to respond to any problems with the ship carrying out the voyage.

Table 1. Marine Highway Security System Components

Entity	Attribute	Activity	Incident	Status Variable
KRI	Surface radar speed, range (endurance), and range	Patrol, anchor, moor	Arrived at the base, arrived at the operation area	The number of boats patrolling, the number of ships that dock
Ship (Pioneer / Sea Highway)	Surface radar speed, range (endurance), and range	Arriving at the port, distribution of goods	Arrive at the port, cruise line	Number of vessels used
Lanal / Posal, Kamladu	Position (latitude-longitude), berth capacity / dock	Providing anchoring facilities, refilling supplies	The arrival of the elements, the departure of the elements	Base status (full, empty, available to re-stock)

3.4 Conceptual Model

The conceptual model is designed according to activities and behavior in the field. On operational KRI, which consists of two elements, carries out operations alternately every two weeks, where when KRI-1 operates, KRI-2 is waiting (standby) at the Surabaya base.

3.5 Model Simulation

The simulation of the existing model is carried out using the Arena simulation model. The simulation model is built from the conceptual model logic and observational data that has been obtained. Observation data processing is done by using the analyzer input on the Arena. In the data distribution fitting process, the type of data distribution chosen is a distribution that is able to produce low squared errors and is in accordance with the distribution of data for similar processes or properties.

3.6 Model Verification and Validation

The verification of the research model is carried out during the construction of the simulation model continuously and continuously during the process of making the simulation program by looking at the logic of the simulation flow with the simulation output results carried out by the computer.

3.7 Verification

Verification is the process of testing the suitability of the simulation model with the conceptual model that has been created. Practically, verification can be done by making sure the model is running properly and correctly according to the logic of the model arrangement. In this study, verification was carried out by checking for errors in the simulation model (errors) using the features check model in the Arena software. From the verification results, it can be seen that no errors in the simulation model were found. This shows that the simulation model has been verified.

3.8 Validation

Validation is the process of determining whether the simulated conceptual model is truly an accurate representation of the real system being modeled. By running each simulation model, the simulation results are obtained based on the operating hours and anchor hours. Furthermore, the simulation results are obtained to compare the time generated in the existing (actual) conditions.

Table 2. Simulation Output and Actual KRI Hours of Operation 1

KRI Hours of Operation 1		
Output To-	Simulation	Actual
1	381,30252	613
2	342.2012844	861.6
3	372.4638841	266
4	386,8353526	311
5	353.9053317	313
6	351,3531076	324
7	339,9204144	314
8	351.0305497	617.45
9	347,0686629	265
10	353.6842513	701.3
11	360.0595343	676
Average	358,1658994	478,3954545
St.dev	15,52977541	216,7774048
Variance	241.1739243	46992,44323

Table 3. Simulation and Actual Output of KRI Anchor Clock 1

KRI Anchor Clock 1		
Output To-	**Simulation**	**Actual**
1	285.7022749	48
2	236,3388498	354
3	248,6469572	138
4	264.7025881	289
5	222.3393087	291
6	235.3118509	296
7	232.9331359	292
8	249.679053	318
9	232.7994919	192
10	240.4438896	366
11	228,6562229	489
Average	243.4139657	279,3636364
St.dev	18,21294024	118.4595059
Variance	331,7111923	14032.65455

Whereas in the KRI 2 simulation calculation, the results of the average operating hours (Table 4.12) were 352.89 hours and the average leg hours (Table 4.13) were 237.61 hours.

Table 4. Simulation Output and Actual KRI Operating Hours 2

KRI Operation Hours 2		
Output Ke-	**Simulation**	**Actual**
1	370,8841717	672
2	344.9010168	664
3	340.7619477	284
4	348.4328101	309
5	358.8827911	305.75
Average	352.7725475	446.95
St.dev	12.14922665	202.038703
Variance	147.6037082	40819,6375

Table 5. Simulation and Actual Output of KRI Anchor Clock 2

Anchor KRI clock 2		
Output Ke-	**Simulation**	**Actual**
1	255.1772111	65
2	241,5971357	243
3	227.3226352	238
4	227.9267827	256.5
5	236.0683899	259.5
Average	237.6184309	212.4
St.dev	11.47252083	82.88802688
Variance	131.6187342	6870,425

From these data, the minimum number of replication simulation models that must be performed can be calculated. The data used to calculate the minimum number of replications is, for example, taken samples of operating hours dataKRI 2. The first step in calculating the model simulation minimum replication is calculating the degree of freedom (df) of the input data. The following is the calculation of the degree of freedom (df) data on KRI 2 operating hours.

$$\mathrm{df} = \frac{\left[\frac{s_1{}^2}{n_1} + \frac{s_2{}^2}{n_2}\right]^2}{\left[\frac{\left[\frac{s_1{}^2}{n_1}\right]^2}{n_1 - 1} + \frac{\left[\frac{s_2{}^2}{n_2}\right]^2}{n_2 - 1}\right]} = 19{,}137$$

Next count half-width (hw) which describes the distribution of data as follows.

$$\mathrm{hw} = t_{\mathrm{df},\alpha/2}\sqrt{\frac{s_1{}^2}{n_1} + \frac{s_2{}^2}{n_2}}$$

$$\mathrm{hw} = (2{,}093)(90{,}518) = 189{,}457$$

After finding the value half-width, the minimal number of replication simulations can be calculated as follows.

$$n = \left[\frac{Z\alpha/_2 \times s_2}{hw}\right]^2$$
$$n = 1{,}663 \approx 2$$

From the above calculations, it can be seen that the minimum replication in the model simulation that should be done is two times. Furthermore, model validation is to test the significance of the difference in the average simulation output with the observational data. The method used in this test is the Welch Confidence Interval method. The model is said to be valid when the confidence interval formed accommodates a value of 0. Validation is carried out for each simulation output data that has been carried out, which includes data on operating hours and anchor hours of KRI 1 and KRI 2 as well as total hours of each voyage of pioneer ships. The following are the steps and calculations of the Welch Confidence Interval method for the validation of each simulation model.

a. Validation of Operating Hours Data Output KRI 1

Hypothesis:
H0 : $\mu_1 - \mu_2 = 0$
HA : $\mu_1 - \mu_2 \neq 0$

Calculation Welch confidence interval for the level of significant:$\alpha = 0{,}05$

$$P[(\overline{x_1} - \overline{x_2}) - hw \leq \mu_1 - \mu_2 \leq (\overline{x_1} - \overline{x_2}) + hw] = 1 - \alpha$$

$$hw = t_{df,\alpha/_2}\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}$$

$$df = \frac{\left[\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}\right]^2}{\left[\frac{\left[\frac{{s_1}^2}{n_1}\right]^2}{n_1 - 1} + \frac{\left[\frac{{s_2}^2}{n_2}\right]^2}{n_2 - 1}\right]}$$

By using data input In table 4.10, the Welch Confidence Interval value using a significance level of 0.05 is as follows.

$$df = \frac{\left[\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}\right]^2}{\left[\frac{\left[\frac{{s_1}^2}{n_1}\right]^2}{n_1 - 1} + \frac{\left[\frac{{s_2}^2}{n_2}\right]^2}{n_2 - 1}\right]}$$
$$df = 19{,}195$$
$$hw = t_{df,\alpha/_2}\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}$$
$$hw = (2{,}093)(65{,}528) = 137{,}152$$

Welch confidence interval 95% confidence level:

$$(\overline{x_1} - \overline{x_2}) - hw \leq \mu_1 - \mu_2 \leq (\overline{x_1} - \overline{x_2}) + hw$$
$$(478{,}395 - 358{,}166) - 137{,}15 \leq \mu_1 - \mu_2 \leq (478{,}395 - 358{,}166) + 137{,}15$$
$$-16{,}923 \leq \mu_1 - \mu_2 \leq 257{,}382$$

Decision:

Because the value of 0 is at the 95% Welch Confidence Interval, then H0 cannot be rejected.

Conclusion:

The difference in the average number of customers from the simulation model output and the observational data is not significant, so the simulation model can be said to be valid.

b. Anchor Clock Data Output Validation KRI 1

Hypothesis:
H0 : $\mu_1 - \mu_2 = 0$
HA : $\mu_1 - \mu_2 \neq 0$

Welch confidence interval calculation for the level of significant:$\alpha = 0{,}05$

$$P[(\overline{x_1} - \overline{x_2}) - hw \leq \mu_1 - \mu_2 \leq (\overline{x_1} - \overline{x_2}) + hw] = 1 - \alpha$$

$$hw = t_{df,\alpha/_2}\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}$$

$$\mathrm{df} = \frac{\left[\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right]^2}{\left[\frac{\left[\frac{s_1^2}{n_1}\right]^2}{n_1 - 1} + \frac{\left[\frac{s_2^2}{n_2}\right]^2}{n_2 - 1}\right]}$$

By using data input In table 4.10, the Welch Confidence Interval value using a significance level of 0.05 is as follows.

$$\mathrm{df} = \frac{\left[\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right]^2}{\left[\frac{\left[\frac{s_1^2}{n_1}\right]^2}{n_1 - 1} + \frac{\left[\frac{s_2^2}{n_2}\right]^2}{n_2 - 1}\right]}$$

$$\mathrm{df} = 19{,}195$$

$$\mathrm{hw} = t_{\mathrm{df},\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

$$\mathrm{hw} = (2{,}093)(65{,}528) = 137{,}152$$

Welch confidence interval 95% confidence level:

$$(\overline{x_1} - \overline{x_2}) - \mathrm{hw} \le \mu_1 - \mu_2 \le (\overline{x_1} - \overline{x_2}) + \mathrm{hw}$$

$$(478{,}395 - 358{,}166) - 137{,}15 \le \mu_1 - \mu_2 \le (478{,}395 - 358{,}166) + 137{,}15$$

$$-16{,}923 \le \mu_1 - \mu_2 \le 257{,}382$$

Decision:

Because the value of 0 is in the Welch 95% confidence interval, then H0 cannot be rejected.

Conclusion:

The difference in the average number of customers from the simulation model output and the observational data is not significant, so the simulation model can be said to be valid.

From the validation that has been done, it is found that the simulation model can produce output that resembles the output of activities in the field. This shows that the simulation model designed has represented the real system behaviorKRI operations and pioneer ship shipping.

3.9 Scenario Combination Analysis

When simulated by combining the two scenarios above, the analysis results show that using 1 KRI, in the operation of guarding the route of the pioneer ship, was unable to cover it with a fast response time when it had to follow the existing patrol route. So the involvement of 2 KRIs in the system will further increase the response time when an event scenario arises.

Table 6. Scenario Combination Simulation Output (10% Probability)

Voyage To-	Time with = 10 Knots$\overline{V}$ (Hour)	Time with = 16 Knots$\overline{V}$ (Hour)
1	4.124902722	5.8980701
2	4,635618035	14.30589461
3	4.317376403	9.397629515
4	17.40058166	3.244932625
5	9,992608288	3.453901122
6	4.19221061	2.934547427
7	7.144422388	6.994825801
8	4.447863086	7.972632789
9	8.263596806	2.585622477
10	9,965790986	13.85611379
11	4.362728598	10.25658074
12	15.66271586	6.610877445
13	17.70943505	12.18040717
14	18.38847979	3.11350416
15	9.784519964	2.530008362
16	4.216680604	3.149320899
17	19.67721967	2.702749542
18	17.88236826	4.257300947
19	15.53478463	3.033608865
20	9.830116833	3.299922178
21	7.077193209	4.286653433
22	15.32095984	12.63114413
23	17.09430124	5.601962063
24	9.336603438	10.62566103
25	8.066430794	15.74177574
26	7.095501578	6.453144635
27	17.32014224	2.617637159
28	4.309370796	10.48763761
29	4.33372695	7.827615971
30	4.504582569	14.71078384
31	15.78893017	4.246315925
32	14.98233945	9.320870776
33	4.499029856	12.25676787
Average	10.22009492	7.229891538
Min	4.124902722	2.530008362
Max	19.67721967	15.74177574

After the simulation is carried out by combining 2 event scenarios, the KRI response output shows the fastest time is 2 hours 53 minutes using a speed of 16 knots. Meanwhile, when using a speed of 10 knots, the KRI response to the incident was 4 hours 15 minutes. Based on the current KRI speed data, it is only able to reach 10 knots, this will slightly hinder the response of the incident.

On the other hand, KRI's response to the 2 incident scenarios has the longest response time, which is about 20 hours 7 minutes with a KRI speed of 10 knots and 16 hours 14 minutes at a speed of 16 knots. It shows that the simulated KRI random position is far from the incident. Thus, a study is needed to improve the operating pattern of securing pioneer shipping routes (R16).

4. CONCLUSION

After doing existing research and based on the results of experiments and analyzes that have been carried out in the previous chapter. So the following are the conclusions that can be drawn in this study:

a. Operations to safeguard the maritime highway, in this case, the pioneer ship shipping route, are activities that have not yet become a concern in the preparation of the TNI AL operational plan. With the results of this study, the concept of security operations can be simulated by combining the two systems, namely the KRI operation and the pioneering shipping process.

b. The result of combining the two systems in a simulation model shows the relationship between time. So that the KRI operation time is a standby in an effort to safeguard the shipping route of the pioneer ship. So that several scenarios of events emerge that can calculate the KRI response time in the act of securing pioneer ships.

c. Determination of event scenarios based on the level of vulnerability in the shipping lanes passed by the pioneer ships by considering historical data of accidents and sea areas with high waves during bad weather. The scenario of the event is obtained from the navigation data and BMKG about water areas that need to be aware of and have a risk level for bad weather so that it needs attention to respond to any events that occur.

d. The output of the simulation program can be concluded that from the two alternative scenarios the existing event demands that the KRI response time be faster when faced with this incident. This achievement will be realized by changing the KRI operating system which adapts to the shipping routes of pioneer ships.

e. With simulations, analysis can be carried out to make real efforts in the field to improve operations and change the patrol route formation to make it more effective. And improving the performance of KRI through repairing or procuring new KRI elements that can increase the tactical response of the security.

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ANALYSIS OF SELECTION OF JOINT TRAINING AREA'S TO INTEGRATE THE ABILITIES OF INDONESIAN SPECIAL FORCES

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ABSTRACT

The Indonesian National Armed Force has special forces that come from the three divisions, the Army, Navy, and Air Force. Even though they are both elite troops, the three dimensions have different combat specialties. A joint scale training is needed to integrate and increase the professionalism of these three special forces dimensions. Therefore, to optimize the ability of these special forces, a training area that is really suitable is needed so that this joint training can run well. This study aims to provide an analytical framework related to the selection of a joint training ground for the TNI special forces. The method used is the Simple Additive Weight (SAW) method. This method is known as the weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes Based on this research, it is concluded that from the available alternatives, the best priority for training sites is Sangatta with a weight value of 0.781, then Natuna with a weight value of 0.768 then Saumlaki with a weight of 0.620.

Key Words : *Special Force, Joint Training, SAW*

1. INTRODUCTION

Along with the development of an increasingly dynamic world with various developments in technology and combat equipment, the need for military qualifications continues to increase. The need for high qualifications can be seen from the development of threats which are currently also growing and complex. If in the past, there were only a few terrorists or other crimes that had adequate combat capabilities. Thus, the combat capabilities of defense crews in each country also adjust to the existing threats. In Indonesia, the Indonesian National Army is a defense crew whose job is to deal with any existing threats.

Currently the Indonesian National Army, as the main component of defense, serves as the main and first fortress in anticipating threats. Based on this function, the TNI must always be ready and develop in accordance with the dynamics of threats and the strategic environment that exists around Indonesian territory. in the last decade, the biggest threats have been terror disturbances and armed militias.

Therefore, the TNI in this case has tactically formed and organized several special forces that are tasked with dispelling and being ready when a latent threat becomes manifest. One that is being developed by the TNI at this time is a special force which consists of three dimensions. Armed with very heavy special training, they are expected to be able to infiltrate enemy territory to prepare the way for regular troops. In addition, they can be deployed to free the victim from being held hostage. This means, each member who is part of the special forces has been prepared for unconventional warfare, which requires special tactics, reconnaissance, attacks on selected targets, to the destruction of high value facilities.

The three-dimensional special forces owned by the TNI are special forces that are formed and prepared separately according to the peculiarities of each dimension. In the Indonesian Army, we know RPKAD (Army Commando Regiment) which later changed its name to Kopassandha and finally Kopassus. Then, there was Kopasgat within the Indonesian Air Force which later changed its name to Korpaskhas. In addition, in the Indonesian Navy there is also Kopaska and Denjaka.

The existence of TNI's special forces which is currently growing, demands a collaboration and cooperation between the three dimensions. This form of collaboration was then developed in the Indonesian National Armed Forces Special Operations Command (Koopssus TNI), which is one of the elite TNI command units which is part of the Central Implementing Agency (Balakpus) which is structurally a direct command under the TNI Commander, so that the special forces of the three dimensions, namely the land dimension, the marine dimension, and the stand-by air dimension at the TNI Headquarters and at any time can be used by the TNI Commander on the orders of the President of the Republic of Indonesia. Meanwhile, the task of the Indonesian Armed Forces Coordinator is to overcome acts of terrorism, both domestic and foreign, that threaten the ideology of sovereignty, the integrity and safety of the entire Indonesian nation.

This paper aims to examine the appropriate place for joint and integrated training by special forces from the three dimensions. The need for an adequate training ground is an absolute must, because these three special combat forces are required to be able to work together and collaborate in each assigned operation. Therefore, with the specifics of each and the various combat abilities, it is necessary to further study the training ground that will be proposed.

The criteria for a special forces training ground should not be chosen randomly without calculation. Many factors must be considered, such as confidentiality, geographical conditions, and whether the place chosen will later be able to support the needs of the three special forces. Currently, there are many training places owned by the TNI, both those that are set as in nature, and in urban settings (Kurniadi, 2014). Therefore a special method is needed, so that the selection of this practice site does not result in an unsuitable choice. There are several ways that can be done, in this case the author will try to use one method, namely Simple Additive Weighting or better known as SAW.

The SAW method in determining decisions has been widely used, and has even become one of the main methods. According to Kaliszewski and Podkopaev (2016) the SAW method is a method of finding a decision on certain criteria. There have been several studies in various fields that have used this method. some of them are Chou, et al (2008) who try to find the location of certain facilities with SAW objective attributes. Likewise Anggraini and Sihotang (2019) who try to find the most appropriate guarding in certain classes. There are many more examples of the use of SAW in implementation which are also very diverse. So it can be stated that SAW is one of the best methods of determining decisions, one of which is in an effort to find the location of the training ground for TNI special forces.

2. SIMPLE ADDITIVE WEIGHTING (SAW) METHOD.

The SAW method is often also known as the weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes. The SAW method requires a decision matrix normalization process (x) to a scale that can be compared with all available alternative ratings. The final steps in using it are:

a. Determine the alternative, namely Ai.

b. Determine the criteria that will be used as a reference in making decisions, namely Cj.

c. Provide a rating of the suitability of each alternative on each criterion.

d. Determine the weight of preference or level of importance (W) of each criterion. W = [W1, W2, W3,…, WJ]

e. Creating a rating table of the suitability of each alternative on each criterion.

f. Creating a decision matrix (X) which is formed from the suitability rating table of each alternative on each criterion. The X value of each alternative (Ai) on each criterion (Cj) that has been determined, where, i = 1,2,… m and j = 1,2,… n.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} \\ \vdots & \cdots & \cdots & \vdots \\ x_{i1} & x_{i2} & \cdots & x_{ij} \end{bmatrix}$$

g. Normalizing the decision matrix by calculating the normalized performance rating (rij) value of the alternative Ai on the Cj criterion.

If j i efit`
If j i

$$rij = \begin{cases} \dfrac{X_{ij}}{Max_i \quad X_{ij}} \\ \dfrac{Min_i \quad X_{ij}}{X_{ij}} \end{cases} \qquad (1)$$

Atribute :

Rij = normalized performance rating value

Xi = attribute value that is owned by each criterion

Max xij = the greatest value of each criterion i

Min xij = the smallest value of each criterion i

Benefit = if the greatest value is best

Cost = if the smallest value is best

Where rij is the normalized performance rating of the alternative Ai on attribute Cj; i = 1,2, ..., m and j = 1,2, ..., n.

h. The results of the normalized performance rating (rij) form a normalized matrix (R)

$$R = \begin{bmatrix} R_{11} & R_{12} & \cdots & R_{1j} \\ \vdots & \cdots & \cdots & \vdots \\ R_{i1} & R_{i2} & \cdots & R_{ij} \end{bmatrix}$$

i. The final result of the preference value (Vi) is obtained from the sum of the normalized matrix row elements (R) with the preference weight (W) corresponding to the matrix column element (W).

$$V_i = \sum_{j=0}^{n} W_j R_{ij} \qquad (2)$$

Attributes :

Vi = ranking for each alternative

Wj = weight value of each criterion

Rij = normalized performance rating value

A larger Vi value indicates that the alternative Ai is preferred

3. DATA PROCESSING

3.1 Determining Alternatives

The alternative choices have been determined by the decision makers according to the table below:

Table 1. Alternative locations

Code	Place	Province
A1	Natuna	Riau Islands
A2	Sangatta	East Kalimantan
A3	Saumlaki	Maluku

3.2 Determining Criteria

The criteria or factors that are taken into consideration are in the table below:

Table 2. Criteria considered

Criteria	B/C	Atribute
Cost (C1)	Cost	How much it costs.
Distance (C2)	Cost	How far is the distance from the base on Java Island.
Facility (C3)	Benefit	How complete are the supporting facilities at the training location.
Geografic (C4)	Benefit	How high is the difficulty level of the training field.

3.3 Provide Rating

Provide a rating value of the suitability of each alternative on each criterion. At this weighting the experts take a range 1-5.

Alternative Rating to the value of the Cost criteria (C1) for the type of Cost criteria.

Table 3. Cost criteria value scale (C1).

No	Cost	Score
1	<= 0,5 M	1
2	0,5M – 1M	2
3	1M – 1,5 M	3
4	1,5M – 2M	4
5	>= 2M	5

After collecting alternative rating data on costs, the following results are obtained:

Table 4. Alternative C1 Value

No	Alternative	Cost	Score C1
1	A1	1 M- 1,5 M	3
2	A2	0,5 M - 1 M	2
3	A3	1,5 M – 2 M	4

b. Rating Alternative to the value criterion Distance (C2) type of Cost criteria

Table 5. Distance Criteria Value C1

No	Distance	Score
1	<= 100 NM	1
2	100 NM – 200 NM	2
3	200 NM – 300 NM	3
4	300 NM – 400 NM	4
5	>= 400 NM	5

After collecting alternative rating data on distance, the following results are obtained:

Table 6. Value of Alternative C2

No	Alternative	Distance	Score C2
1	A1	100 NM- 200 NM	2
2	A2	200 NM - 300 NM	3
3	A3	>= 400 NM	5

a. Alternative Rating on the value of the Facility criteria (C3) for the type of Benefit criteria

b.

Table 7. Facility criteria value scale (C3).

No	Fasility	Score
1	Incomplete	1
2	Less Complete	2
3	Complete	3
4	Quite Complete	4
5	Very Complete	5

After collecting alternative rating data for the facility, the following results are obtained:

Table 8. Alternative C3 Score

No	Alternative	Facility	Score C3
1	A1	Complete	3
2	A2	Complete	3
3	A3	Very Complete	5

c. Alternative Rating against the Geographical criteria value (C4) for the type of Benefit criteria

Table 9. Geographical criteria value scale(C4).

No	Geografis	Score
1	Not Dificult	1
2	Less Dificult	2
3	Dificult	3
4	Quite Dificult	4
5	Very Dificult	5

After collecting alternative rating data to Geographical, the following results are obtained:

Table 10. Value of Alternative C4

No	Alternative	Geographical	Score C4
1	A1	Quite Dificult	4
2	A2	Dificult	3
3	A3	Very Dificult	5

3.4 Determine the weight of preference

Determine the weight of preference or level of importance (W) of each criterion. W = [W1, W2, W3,…, WJ]. The weight of the criteria is determined by the decision maker or determined by himself. In this case study, it is

Assumed that the weight value has been obtained from the paiwase comparation process. That is:

Table 11. Weights of each criterion.

No	Code	Weight	
1	C1	30	0,3
2	C2	30	0,3
3	C3	20	0,2
4	C4	20	0,2
	Total	**100**	**1**

a. Create a rating table of the suitability of each alternative on each criterion.

Table 12. Ratings of alternatives on criteria

No	Alternative	Criteria			
		C1	**C2**	**C3**	**C4**
1	A1	3	2	3	4
2	A2	2	3	3	3
3	A3	4	5	5	5

b. Make a decision matrix (X) which is formed from the suitability rating table of each alternative on each criterion.

$$X = \begin{bmatrix} 3 & 2 & 3 & 4 \\ 2 & 3 & 3 & 3 \\ 4 & 5 & 5 & 5 \end{bmatrix}$$

c. Normalizing the decision matrix by calculating the normalized performance rating (rij) value of the alternative Ai on the Cj criterion.

$$rij = \begin{cases} \dfrac{X_{ij}}{Max_i \quad X_{ij}} \\ \dfrac{Min_i \quad X_{ij}}{X_{ij}} \end{cases}$$

For columns 1 and 2 in the X matrix, because they are cost, they use the formula:

$$rij = \frac{Min_i \quad X_{ij}}{X_{ij}}$$

The solution is:

$$r_{11} = \frac{\min\{3,2,4\}}{3} = \frac{2}{3} = 0{,}67$$

$$r_{21} = \frac{\min\{3,2,4\}}{2} = \frac{2}{2} = 1$$

$$r_{31} = \frac{\min\{3,2,4\}}{4} = \frac{2}{4} = 0{,}5$$

$$r_{12} = \frac{\min\{2,4,5\}}{2} = \frac{2}{2} = 1$$

$$r_{22} = \frac{\min\{2,4,5\}}{3} = \frac{2}{3} = 0{,}67$$

$$r_{32} = \frac{\min\{2,4,5\}}{5} = \frac{2}{5} = 0{,}4$$

Furthermore, columns 3 and 4 which have Benefit properties, then use the formula:

$$rij = \frac{X_{ij}}{Max_i \quad X_{ij}}$$

The solution is :

$$r_{13} = \frac{3}{\max\{3,3,5\}} = \frac{3}{5} = 0{,}6$$

$$r_{23} = \frac{3}{\max\{3,3,5\}} = \frac{3}{5} = 0{,}6$$

$$r_{33} = \frac{5}{\max\{3,3,5\}} = \frac{5}{5} = 1$$

$$r_{14} = \frac{4}{\max\{4,3,5\}} = \frac{4}{5} = 0{,}8$$

$$r_{24} = \frac{3}{\max\{4,3,5\}} = \frac{3}{5} = 0{,}6$$

$$r_{34} = \frac{3}{\max\{4,3,5\}} = \frac{5}{5} = 1$$

d. The results of the normalized performance rating value (rij) form a normalized matrix (R).

$$R = \begin{bmatrix} 0{,}67 & 1 & 0{,}6 & 0{,}8 \\ 1 & 0{,}67 & 0{,}6 & 0{,}6 \\ 0{,}5 & 0{,}4 & 1 & 1 \end{bmatrix}$$

e. Calculating the value of preference (Vi)

$$V_i = \sum_{j=0}^{n} W_j R_{ij}$$

$$W = (0{,}4|0{,}3|0{,}2|0{,}1|)\ R$$

$$= \begin{bmatrix} 0{,}67 & 1 & 0{,}6 & 0{,}8 \\ 1 & 0{,}67 & 0{,}6 & 0{,}6 \\ 0{,}5 & 0{,}4 & 1 & 1 \end{bmatrix}$$

$$A1 = (0{,}4\,.\,0{,}67) + (0{,}3\,.\,1) + (0{,}2\,.0{,}6) + (0{,}1\,.\,0{,}8) = 0{,}768$$

$$A2 = (0{,}4\,.\,1) + (0{,}3\,.\,0{,}67) + (0{,}2\,.0{,}6) + (0{,}1\,.\,0{,}6) = 0{,}781$$

$$A3 = (0{,}4\,.\,0{,}5) + (0{,}3\,.\,0{,}4) + (0{,}2\,.\,1) + (0{,}1\,.\,1) = 0{,}62$$

4 CONCLUSION

The Special forces desperately need a place to carry out joint exercises. Determination of the alternative joint training area's is determined by criterias and methods. From data processing using the Simple Additive Weighting (SAW) method the results were: A1 = 0.768, A2 = 0.781 A3 = 0.620. Thus the selected location for the joint training of the TNI special forces was A2, namely Sangatta in East Kalimantan.

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DESIGN OF PERFORMANCE MEASUREMENT SYSTEM IN PUSPEKNUBIKA KODIKLATAL

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ABSTRACT

The success or success of an organization is achieved because of the ability of the organization in carrying out its vision and mission as expected, as it is known that one of the objectives of the process of organizing the functions of government is the guarantee of national security and welfare conditions for all its people. The purpose of the research was to obtain measurements of organizational performance by BSC method in Puspeknubika Kodiklatal Surabaya. In the test of variable validity of customer satisfaction level in service attributes for comfort criteria as much as 67.3%, criteria of ability to meet the needs as much as 71.7%, health and safety criteria as much as 65.1%, criteria of ability to provide the required information as much as 84.4% and good communication criteria as much as 65%. Balanced Scorecard (BSC) method can be applied to government and military organizations, especially in this case Puspeknubika Kodiklatal Surabaya, because with this method all aspects can be measured and known performance.

Keyword : Performance measurement, Balance Scorecard, Puspeknubika

1. Introduction

Performance measurement is a tool to assess an organization's success. In the context of government organizations and organizations of the Indonesian National Army (TNI), the success or success of an organization is achieved because of the ability of the organization in carrying out its vision and mission as expected, as it is known that one of the objectives of the process of organizing government functions is the guarantee of national security and welfare conditions for all its people, to achieve this, the TNI organization must be able to carry out its basic duties as the main component of the country's defense to the maximum , with this, it is undeniable that a TNI organization needs to measure its performance in order to know if its strategic objectives have been achieved. Currently, many models have been implemented in performance measurement systems such as: Balanced Scorecard, Integrated Performance Measurement System (IPMS), and Performance Prism. Balanced Scorecard is the most popular performance measurement system model today (Neely, 2003). The balanced scorecard performance measurement method was chosen in this study because it has advantages over the other two methods, in performance prism and IPMS method focuses more on identifying stakeholders from many interested parties, such as owners and investors, suppliers, customers, labor, government and surrounding communities without taking into account other activities. While the balance scorecard with the other two methods is in addition to considering the financial aspect, the balance scorecard also considers the non-financial aspect. The balance scorecard measures not only the final result, but also the activities of the final result determinant. The balance scorecard application also includes growth and learning activities, which can contribute to the organization. Therefore, balanced scorecard is considered appropriate to be applied to public organizations and TNI. This is in line with the objectives of public organizations that place qualitative and non-financial services as a top priority. Puspeknubika Kodikdukum is an implementing element in Kodiklatal in charge of assisting Dankodikdukum in the implementation of courses, training and practices in the field of ship rescue from fire hazards, ship damage, as well as training in dealing with nuclear, biological and chemical hazards. Preparing, organizing and evaluating the results of courses, exercises and practices, as well as carrying out the construction of its entire power line, including the facilities and infrastructure supporting the organization to support the main tasks of Kodiklatal Kodikdukum. Based on these problems, the purpose of the research is to obtain measurements of organizational performance with BSC methods in accordance with the vision and mission that has been determined in Puspeknubika Kodiklatal Surabaya.

2. Materials and Methods

Balanced Scorecard is one of the methods of performance measurement that translates missions and strategies into various objectives and sizes, which are organized into four perspectives: finance, customer, internal business process, and learning business and growth (Kaplan and Norton, 1996). This method of measurement not only focuses on the financial aspect but also emphasizes other aspects that are the driving factors of the performance of the financial objectives.

The use of the name "Balanced Scorecard" describes the balance between short-term and long-term goals, between financial and non-financial measures, between logging indicators and leading indicators and between external and internal perspectives (Kaplan and Norton, 1996).

The word "balanced" in Balanced Scorecard means that:

a. A measure of performance, representing every perspective available.

b. Performance measures represent the results of past actions (financial) and measures that are the driving factors of future performance (customer, internal business process, learning &growth).

c. Performance measures that represent objective and subjective measures.

According to Kaplan and Norton balanced scorecard measures include four new management processes. This approach combines long-term strategy goals and short-term events. The four processes are:

a. Translating the vision, mission and strategy of the company.

To determine the size of performance, the vision of the organization is outlined in goals and objectives. Vision is a picture of the conditions that will be realized by the company in the future. The goal is also one of the foundations for the formulation of strategies to make it happen.

b. Communicate and associate various strategic objectives and sizes.

Balanced scorecard shows each personnel what the company does to achieve what shareholders and consumers want, because therefore it takes good employee performance.

c.Plan, set goals, align various strategic initiatives.

Business plans allow organizations to integrate between their business plans and financial plans. Balanced scorecard as the basis for allocating resources and managing which is more important to prioritize, will move towards the long-term goals of the company as a whole.

c. Plan, set goals, align various strategic initiatives.

Business plans allow organizations to integrate between their business plans and financial plans. Balanced scorecard as the basis for allocating resources and managing which is more important to prioritize, will move towards the long-term goals of the company as a whole.

d. Improve strategic feedback and learning.

This fourth process will provide strategic learning to the organization. With Balanced scorecard as the center of the company's system, the company conducts monitoring of what the organization in short term.

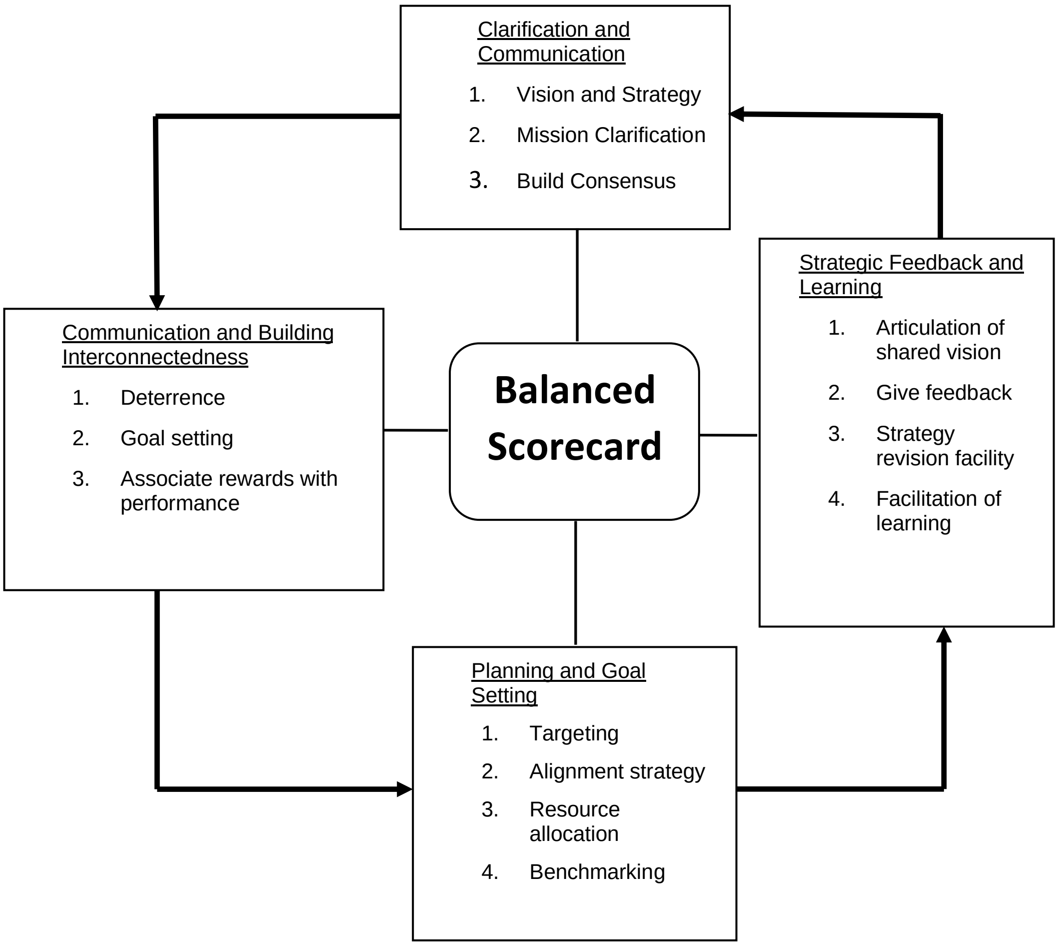


Figure 2.1 Balanced Scorecard as a framework of strategy management actions. (Source : Kaplan &Norton,1996)

There are 3 models that can be used to determine performance measures, namely:

1) Program *logic* model.

The *logic* model program shows the relationship between 4 types of performance measures i.e. inputs (what is used to generate *value),*processes (how input transformations into products or services), outputs (what is produced) and *outcomes* (what is achieved). For public organizations, one size is added that is *intermediate outcome* to bridge between output and *outcome.* This model can be seen in the image below.

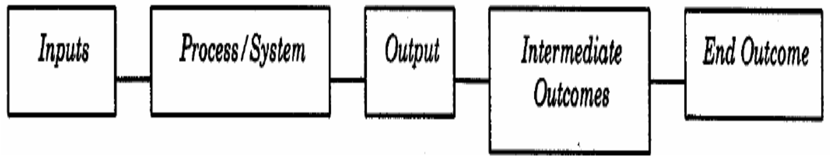


Figure 2.2 *Logic Model Program*.
(Source : Rohm,2003)

2) Causal analysis.

This model describes the causal relationship of a performance. It starts by determining the effect and then identifying the cause that resulted in the achievement of the result. This model can be seen in the image below.

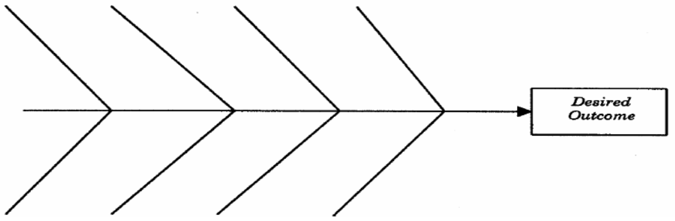


Figure 2.3 Causal Analysis.
(Source : Rohm,2003)

3) Process flow

Process flow identifies the activity or size that produces the desired outcome by describing the flow of actions performed. This model can be seen in the picture below. Outcome by describing the flow of actions to be taken. This model can be seen in the picture below.

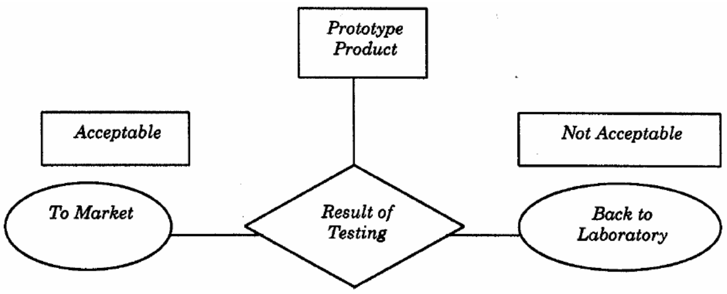


Figure 2.4 Process Flow. (Source : Rohm,2003)

Scoring System and Traffic Light System

Scoring System is required to know the achievement score against a predetermined target. Some of the methods that will be used are:

a. Higher is better indicates the higher the achievement, the better the indication and the higher the score,

b. Lower is better indicates the lower the achievement, the better the indication and the higher the score

c. Must be zero indicates the higher the achievement must be zero and if not zero then the worse or worse so that the score is lower.

d. Must be one indicates the lower the achievement must be one (100%) and if not then the indications are getting worse or worse so that the score is lower.

The approach used is to calculate the performance score of a KPI is to compare the actual value with the target. By applying the principle *of higher is better.*

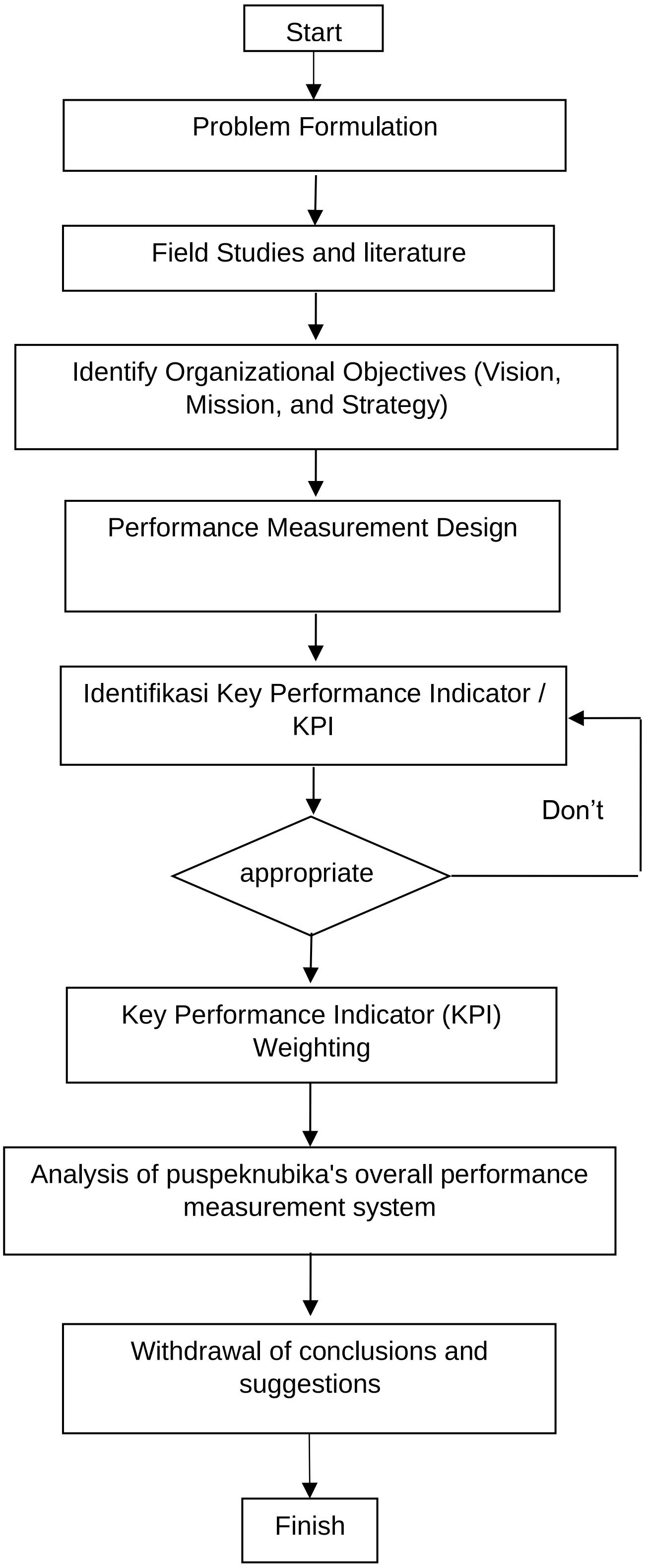
$$Score = \frac{Actual}{Target}$$

If using the principle *of lower is better* then on the contrary that the target is divided into actual.

$$Score = 2 - (\frac{Target}{Actual})$$

Traffic light system is closely related to scoring system. Traffic light system serves as a sign whether kpi score' requires an improvement or not. The indicator of this traffic light system is represented by the following colors:

a. Green color, given to key performance indicators that reach a value between the levels of 80% - 100%, means that the achievement of a performance indicator has been achieved, equal, or even exceeded the target.
b. Yellow color, given to key performance indicators that reach a value between the levels of 40% - 70%, means that the achievement of a performance indicator is quite achieved even though the value is close to the target. So the management must be careful with the existence of various possibilities.
c. Red color, given to key performance indicators that reach a value between the levels of 0% - 30%, means that the achievement of a performance indicator is completely below the target set and requires imedite improvement. (Suwignjo and Vanany, 2004) target set and requires immediate improvement. (Suwignjo and Vanany, 2004)



Picture. Observation Flow chart

A study, especially scientific research requires a clear, systematic and directed frame in the thought process based on the problem that is being reviewed so that the research process and results will be obtained later in accordance with expectations. The frame of mind in this study is then called the research method. Where the research method is used to compile a study so that the direction and objectives become clear that can eventually be obtained a conclusion that answers the problems that have been formulated. In this section will be explained about the steps that will be taken in completing the research. The types of data collected in this study are qualitative and quantitative data consisting of primary data and secondary data. Primary data obtained directly during research in Puspeknubika and elements of implementing activities in the ranks of Puspeknubika.

The outline of all activities carried out during the research is described in the flow chart as described in the image below.

From the flow chart above, it can be explained about the stages of this research method as follows:

a. Problem Formulation

The formulation phase of the problem is the first step in the process of working on this Final Task research. The formulation of problems in this study is analyzing performance indicators and measuring performance in Puspeknubika Kodiklatal Surabaya with balanced scorecard method so that later can improve better performance in the organization.

b. Field Studies And Literature

This stage is the beginning of research conducted with the aim to know the general description of Puspeknubika Kodiklatal Surabaya to be researched by data collection techniques conducted by direct to research objects by:

1) Observation Method.

Namely the method of data collection by conducting observations directly in the field.

2) Interview method.

It is a method of collecting data with Q&A directly to leaders and Members.

3) Questionnaire Method.

It is a method of data collection by providing a list of questions to respondents to fill out. To determine whether the results of the questionnaire is said to be valid and reliable, a 2-stage test is conducted, namely validity test and reliability test. Validity tests are intended to determine the extent to which the gauge used can measure what will be measured. The validity test in this study is intended to find out if the questionnaire prepared has been able to measure the variable that you want to measure. Validity tests are conducted by calculating the correlation of each question (item) with its total score. The correlation formula used is Pearson Correlation. Testing is done using spss program.

The types of data collected and used in this study are:

1) Primary data, i.e. data directly collected or obtained from research objects and opinions

2) Secondary data, namely data obtained indirectly from research objects, but has been compiled in the form of written documents that have been owned by Puspeknubika Kodiklatal Surabaya

c. Identification of Objectives.

This stage begins by collecting the necessary data so that it can be analyzed and identified puspeknubika vision, mission, and strategy that will be used into the preparation of objectives and key performance indicators, the data needed, namely the vision, mission and objectives of Puspeknubika.

d. Design of Performance Measurement

At this stage the data collection that has been done and then processed with the steps are as follows:

1) Identify performance from each of the existing perspectives

2) Customer identification data and stakeholders. It is also conducted by interview and questionnaire methods.

3) Determine the strategies and priorities needed in kpi preparation. This determination is done taking into account conducted by interview method.

4) Taking into account the categories required in analyzing the criteria so that the resulting ones that may be required are effective and efficient.

5) Develop performance measurements using balanced scorecard method.

e. Identification of Key Performance Indicators (KPIs)

Identification of this KPI is done by conducting discussions and questionnaires with the management of Puspeknubika Kodiklatal Surabaya., Identification of this KPI is useful to know the right measure of performance and can be used in measuring the performance of Puspeknubika so that later after the strategic objectives to be achieved by Puspeknubika Surabaya.

f. KPI Weighting Stage

In this study weighting was done by the most ideal method, namely by involving the management group. The method used in this weighting is to use the AHP method. The ways or processes are as follows:

1) Dissemination of questionnaires containing questions about the priorities of all the criteria that have been set, to management groups that are considered to be completely aware of the intricacies of the organization.

2) Each group member individually gives priority to the criteria.

3) Processing is done using Expert Choice 2000 software.

4) The processing result has inconsistency ratio provisions that should not be more than 0.1.

5) The resulting value is the weight of the criteria.

g. Calculation of KPI Achievement With Traffic Light System

The data required in this weighting stage is the value of importance weights, the actual values that have been achieved and the targets that must be achieved, of each KPI. The calculation of performance achievement score of each performance indicator is generated by comparing the achievement result against the target by using scoring system. The importance weight value of the previous step, multiplied by the performance achievement score to get the weighted score. Furthermore, weighted scores are classified into red, yellow and green colors with traffic light system methods to facilitate in determining the priority of improvement for KPIs

h. Performance Measurement System Analysis

This stage provides an overall analysis and review of the results of data processing. This stage consists of several parts:

1) Analyze objectives and key performance indicators

Analysis of objectives and key performance indicators that have been identified and analysis of the relationship between objectives that have been identified.

2) Performance measurement system

Provide advice in the form of an identified system based on previously obtained data, namely data on performance measurement results in Puspeknubika Kodiklatal Surabaya

i. Withdrawal of conclusions and suggestions

The conclusion and suggestion stage contains the withdrawal of conclusions on the results obtained earlier and provide suggestions based on the results of performance measurements that have been done to the Puspeknubika Kodiklatal Surabaya.

3. Discussion and Results of Research

At this stage the calculation and analysis of data is based on historical data puspeknubika in the form of work program evaluation report and Government Agency Accountability Report (LAKIP) Puspeknubika Kodiklatal. The data used is the 2010 and 2011 data. The KPI achievement indicator of this traffic light system is represented by the following colors:

A.. Green color, given to key performance indicators that reach a value between the levels of 80% - 100%, means that the achievement of a performance indicator has been achieved, equal, or even exceeded the target.

b. Yellow color, given to key performance indicators that reach a value between the levels of 40% - 79%, means that the achievement of a performance indicator is quite achieved even though the value is close to the target. So the management must be careful with the existence of various possibilities.

c. Red color, given to key performance indicators that reach a value between the levels of 0% - 39%, means the achievement of a performance indicator is completely below the target set and requires immediate improvement.

Traffict Light	percentage	Reach
	80%-100%	Reached
	40%-79%	Simply Achieved
	39% down	Not Reached

Data required in calculating kpi achievement score in customer and stakeholders perspective, namely training participant support data, training facilities maintenance and improvement data and BBM support usage data in 2010 and 2011.

a. Percentage of the number of support participants served

No.	year	Training participant support requests	Training participant support	percentage	Reach	Traffict Light
1	2010	59	59	100%	Reached	
2	2011	40	40	100%	Reached	

b. Improving infrastructure facilities

No.	year	Number of Harkan Alins	Maintenance and Repair of Alins	percentage	Reach	Traffict Light
1	2010	8	7	87%	Reached	
2	2011	8	6	75%	Simply Achieved	

c. Use of Lattek Fuel

No.	year	Fuel emitted (liters)		Fuel Demand (liters)		percentage		Reach	Traffict Light
		MT-88	HSD	MT-88	HSD	MT-88	HSD		
1	2010	285	785	285	220	100%	92%	Reached	
2	2011	475	475	475	475	100%	100%	Reached	

To know the feasibility and reliability of the survey results, it is conducted with validity test and reliability test. Validity test using product moment correlation, resulting in r-count value which is the value of Corrected Item Tota Correlation greater than r-table (rhitung > rtabel), so that each item of question 18 in the questionnaire is declared valid. Reliability test using SPSS program version 17.0, generated Cronbach's Alpha value is 0.802 for job satisfaction rate and 0.824 so cronbach's Alpha value > 0.60 and questionnaire is declared reliable.

Perspektif	***KPI***	**Realisation**		**Score**		**Weight**	**Weighted Score**	
		2010	**2011**	**2010**	**2011**		**2010**	**2011**
Customer and Stakeholders	Percentage of sea freight support served	100%	100%	10	10	0,061	0,61	0,61
Financial	Number of Harkap implementations	87%	75%	8	7	0,028	0,224	0,196
	Number of BBM support usages	92%	100%	9	10	0,034	0,306	0,34

Perspective	Weighted Perspective	Weighted Score			
		2010		2011	
Customer & Stakeholder	0,292	8	2,336	8	2,336
Financial	0,164	10	1,640	10	1,640
	End Value	3,376		3.376	
	Criterion	Reached		Reached	

From the results of data processing design performance measurement with balanced scorecard method in Puspeknubika Kodiklatal Surabaya, it can be drawn some conclusions, namely

Balanced Scorecard Method (BSC) can be applied to government and military organizations, especially in this case Puspeknubika Kodiklatal Surabaya. Puspeknubika Kodiklatal Surabaya makes it possible to implement a performance measurement system with a balanced scorecard method, because with that method all aspects can be measured and known performance and balanced scorecard has formulated its vision, mission and strategy into the strategic objectives that have been expected.

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THE STRATEGY ANALYSIS FOR DEVELOPMENT OF INDONESIAN NAVY COMBAT CAPABILITIES

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ABSTRACT

Warships are one of the main components of the Navy having the main task of maintaining national security and defense at sea. Based on a research study in 2019, the age of warships over 30 years is 60% which has an impact on the decline in the performance of warships. A strategy is needed to improve the performance of warships to achieve the implementation of its main duties and functions as a means of defense. To solve this problem, it is necessary to pay attention to and consider several aspects, both internally and externally through the dynamic system approach method with the Causal Loop Diagram (CLD) model which emphasizes the impact of dynamic aspects associated with influential cause and effect problems. The selected strategies include human resource development, operational readiness, capability development, and increased interoperability.

Keywords : CLD, STELLA, System Dynamiic.

1. INTRODUCTION.

The national defense system is a universal defense system that involves all citizens, territories, and other national resources which are prepared early by the government and implemented in a total, integrated, directed, and continuous manner to uphold state sovereignty, territorial integrity, and the safety of all nations from all over the world. threat. And one of the aspects that play a major role in realizing national defense is the role of the Indonesian National Army which is the main component in realizing this condition, especially in the field of defense which has the main task according to Law no. 34 of 2004, namely upholding state sovereignty, maintaining the territorial integrity of the Unitary State of the Republic of Indonesia. In the framework of carrying out these main tasks, it is absolutely necessary to have Combat Readiness and High Combat Capability.

Combat Capability is highly dependent on Combat Readiness which is determined by five elements namely Personnel, Main Equipment Weapon Maintenance System, Training, and Work Safety. Combat readiness is of paramount importance to our national security and is used in the management of our military resources to make an understanding of what combat readiness is and how to achieve it very important to military managers. A 2010 DoD report defines combat readiness as: “Readiness refers to the capability to respond adequately diverse situations and to sustain that response as long as necessary. The readiness of defense combat forces depends on a myriad of diverse and often interrelated aspects ". With the limited budget given will affect the condition of the Navy's Alutsista and professionalism, in addition to the number and technology that are still far behind when compared to other countries, many of the Alutsista are very old and no longer worthy of use. Most of the Navy's Alutsista are in critical condition because they have exceeded the age limit, while their replacements are not ready. This is very concerning because, with the current threats, we need to build and maintain the readiness of the Indonesian Navy's defense equipment and weaponry. therefore a policy strategy is needed for navy posture development. In this study, using a dynamic systems approach to determine the relationship between variables behavior which is then made a simulation according to reality.

2. MATERIALS/METHODOLOGY

2.1. Simulation Software

To design a dynamic system simulation model, it is necessary to choose the right software and be able to evaluate the behavior description of a model. In the dynamic system model, there are three types of variables, namely Level / Stock, Rate / Flow, and Auxiliary.

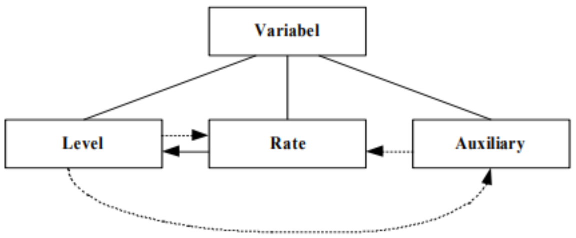

Figure 1. model System Dynamic(Sushil,1993)

Modeling using Software System Thinking Educational Learning Laboratory with Animation (STELLA):

a. Rate is an activity, movement, or flow that contributes to changes per unit time in the Level variable. Rate is the only variable that affects the Level variable. This symbol must be connected to the Level variable. The variable name is shown at the bottom of the symbol.

b. The Level is a variable that can accumulate over a period of time. The level variable is influenced by the Rate variable. The Level symbol is a rectangle with the variable name listed at the top of the symbol.

c. The converter holds constant values, which define the external input to the model, calculates algebraic relationships, and serves as a repository for graphical functions. In general, it converts input to output. The converter name is displayed at the bottom of the symbol.

d. This connector is used to connect the various elements of the model. The connection can be between Level, between Converter, Rate to Converter, Converter to Rate, and Level to Converter.

Table 1. Simbol Stock and Flow Diagram

Simbol	Keterangan
Noname 1	Level/Stock
Noname 2	Rate/Flow
Noname 3	Converter
	Connector

2.2 Causal Loop Diagram (CLD)

According to Sushil (1993), a causal loop diagram is a disclosure about the occurrence of a causal relationship (causal relationship) into the language of images certain. The language of the image is an interlocking arrow, so that forms a causal loop where the upper reaches of the arrow reveal the cause and the arrowhead reveal the effect. Both, whether the element of the cause or cause-effect or any one of them (cause only or effect only) must refer to measurable conditions, both qualitatively for the perceived state and quantitatively for the actual situation (actual).

The approach through the CLD model has several advantages, including:

a. Encourage to be able to see the problem as a whole, both in terms of scope and time to prevent narrow thinking.
b. The description of the chain of causal relationships makes it more explicit and the rationale is better.
c. Allows effective communication to run and the realization of teamwork will be better.
d. Help explore alternative policies and decisions so that the consequences can be anticipated in advance.
e. Allows the existence of a good position to make decisions

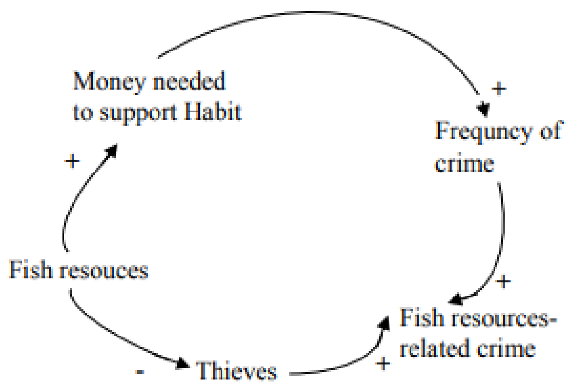

Figure 2. Causal loop diagram

Therefore, the steps needed for modelling and simulating of complex systems based on systems thinking are:

a. Identify the problem.
b. Develop a dynamic hypothesis explaining the cause of the problem.
c. Create a basic structure of a causal graph.
d. Augment the causal graph with more information.
e. Convert the augmented causal graph to a system dynamics flow graph.
f. Translate a system dynamics flow graph into STELLA.

2.3 Model Verification and Validation.

The next stage after the initial model simulation is the verification and model validation stage. This stage aims to ensure that the model is verified and validated so that it can be ascertained that the model is running well. Model verification and validation also aim to determine whether there are errors/errors in the model. Model verification and validation can also be a process to compare the structure of the model and its behavior to the actual system structure and behavior so that it can be said that the model is able to represent the real system. In this study, verification was carried out by carrying out the model unit test, while the model validation was carried out by carrying out the model structure test and model parameter test. Model unit tests and parameter tests were carried out with STELLA software.

The verification stage is carried out by examining the model equations and examining the unit (unit) variables of the model. If there are no errors in the model, it can be said that the model has been verified / valid internally.

2.4. Flow Diagram.

An outline of all research activities is illustrated in a flowchart as in the following figure:

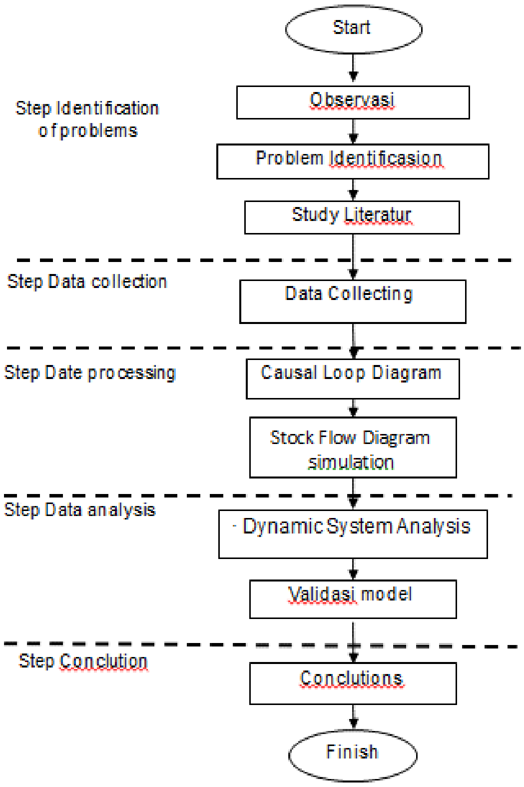

Figure 3. Research Flowchart

3. RESULT AND DISCUSSION

3.1 Aspects that influence strategy

The policies in an organization are general guidelines for carrying out the activities and decisions of the people in the organization. A policy is usually a statement that can guide organizational members on how they should act in certain situations. Strategy according to Mintzberg and Quinn (1991) is a pattern or plan that integrates the main goals of the organization, policies, and actions into an integrated linkage. A good strategy is expected to help integrate various interests. For the internal interests of the organization, the strategy is expected to be able to assist in the utilization and allocation of organizational resources. Meanwhile, for the external interests of the organization, a strategy is expected to be able to help anticipate environmental changes.

Based on the results of the meeting of the Indonesian defense ministry in 2021, it produced 4 policy focuses to be used as guidelines in increasing the combat capability of the Indonesian navy.

Table 2. Aspects.

No	Aspect	Indicator
1	**Interoperability**	• The existence of joint training, • Commonality of Alutsista and its supporters. • Network centric warfare (NCW) • Information warfare (IW) • Maritime security synergy • Information systems based on centralized navy data, • Cooperation between other state defense tools
2	**Human resources**	• The HR management system by fulfilling the needs of personnel • Reducing personnel in the pendirat • Ruilding satdik outside Java • Recruitment priorities for regional men and athletes with achievement • Synchronization of personnel strength with modernization of Alutsista • Merit system • The right man on the

		right place • Educational investment
3	**Navy Capability**	• The ability to carry out four joint operations • Modern navy warfare • Special navy warfare • Mobility and fire power • Military duties other than war • Optimal base support facilities • Maritime ISR coverage • Cyber attack protection.
4	**Navy Operational**	• The success of operations based on outputs and outcomes • Focus on maintenance Alutsista • Maintenance of defense equipment • Acceleration of procurement • elimination of basic equipment supplies • Stock of operational BMP needs • Training and personnel graduation

3.2 Causal Loop Diagram.

CLD is made to show the main variables, in this case, it is arranged based on the initial variables that have been identified. In this model, a causal relationship that occurs between variables that affect the system is shown. For example, in the aspect of improving Human resources, is influenced by the existence of Lemdik, for the improvement of Lemdik, it is necessary to have a doctrine that embodies it so that it will have an impact on increasing the strength of the Navy.

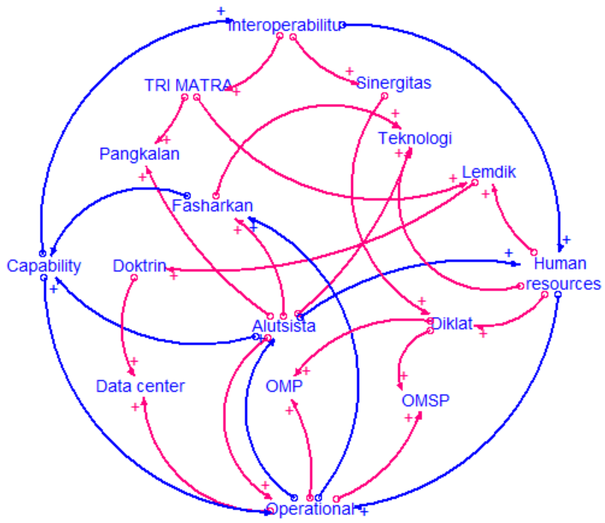

Figure 4. CLD

With the causal loop diagram above, it can be understood the relationship, as well the influence of variables on system behavior. All variables are influential in the system is involved in the model and shows its feedback / reciprocal relationship depicted as the level / stock at the time of model simulation.

3.3 Main Modul.

The module image below is a structuralization of the model and system that occurs in Increased navy strength. The structuralization is modeled in the main module form of all the that variables affect the strength of the Navy. From the conceptualization, it can be seen that the strength of the Navy is influenced by the dynamic development of the system from the aspects of Capability, Human resources, operational and technical interoperability. The elements that affect the four main variables are defined by the identification of the variables that have been done previously

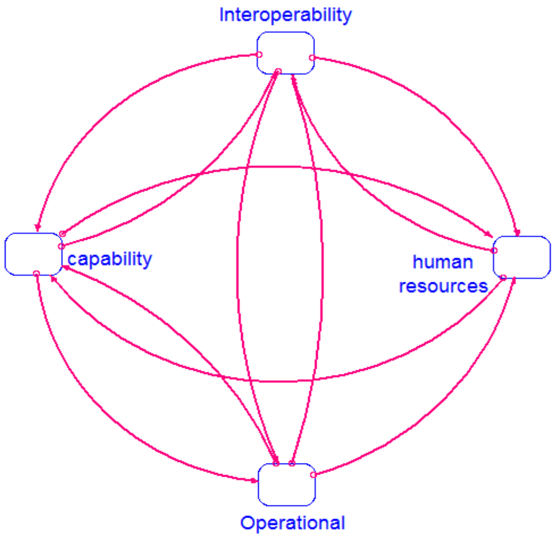

Figure 5. Main Modul diagram

3.4 Verification & validation.

At this stage, verification is carried out by checking the model equations and checking the unit (unit) variables of the model. If there are no errors in the model, it can be said that the model has been verified / valid internally. which is the internal model validation in the form of unit model validation and equation models that are run on model simulations, where the program is running well, without errors in units or formulations (equations) with an OK indicator on the model, so the model can be said to be valid from the unit aspect and equation.

3.5 Interoperability aspect.

Identified as a system for measuring the value of navy forces that is integrated within the framework of the SSAT navy and is integrated with the forces of the army and air forces in an integrated tridimensional framework.In this aspect it is influenced by the existence of joint training, commonality of Alutsista and its supporters. Network centric warfare (NCW) and information warfare (IW), maritime security synergy, information systems based on centralized navy data, cooperation between other state defense tools

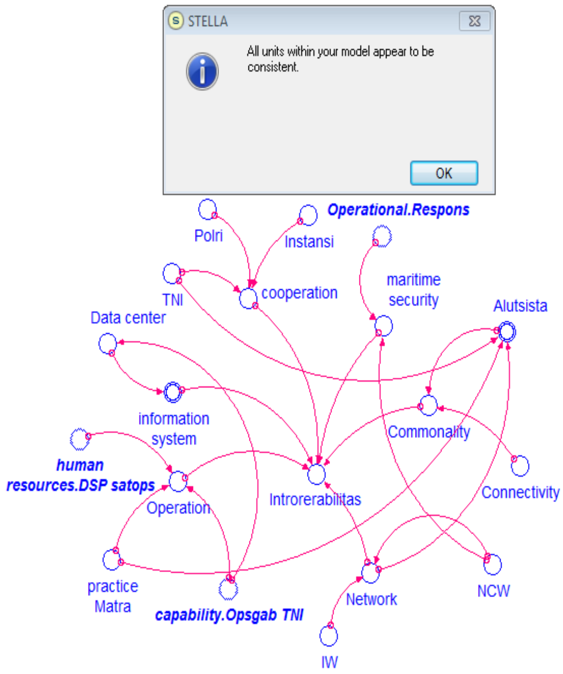

Figure 6. Sub Model Interoperability

3.6 Human resources aspect.

Identified as a system for measuring the value of the ability of personnel, professionals in their fields, competency standards according to the duties of authority and responsibility of the position and having character, enthusiasm and high mental struggles.

In this aspect it is influenced by the HR management system by fulfilling the needs of personnel and reducing personnel in the pendirat, building satdik outside Java, recruitment priorities for regional men and athletes with achievement, synchronization of personnel strength with modernization of Alutsista, Merit system and the right man on the right place. , educational investment.

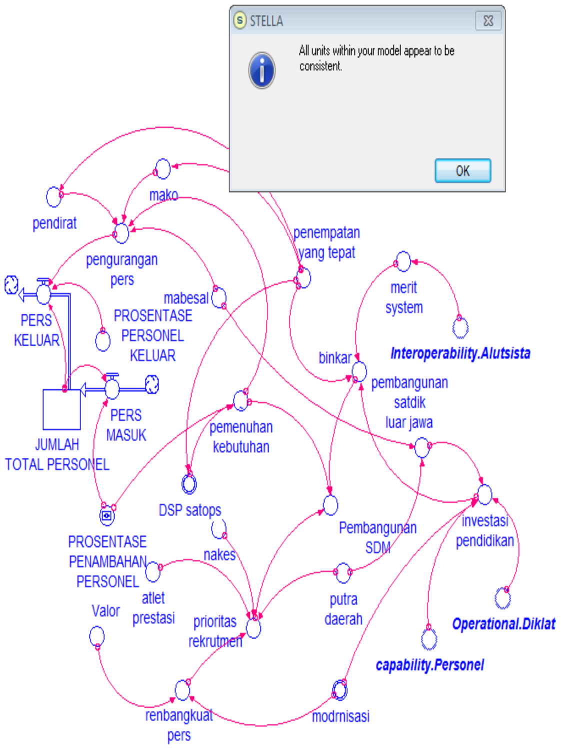

Figure 7. Sub Model Human resources.

3.7 Capability aspect.

Identified as a system for measuring the value of navy forces which have high mobility, destructive force and high vibration effects. In this aspect it is influenced by the ability to carry out 4 joint operations, modern navy warfare and special navy warfare, mobility and fire power, military duties other than war, optimal base support facilities, maritime ISR coverage, cyber attack protection.

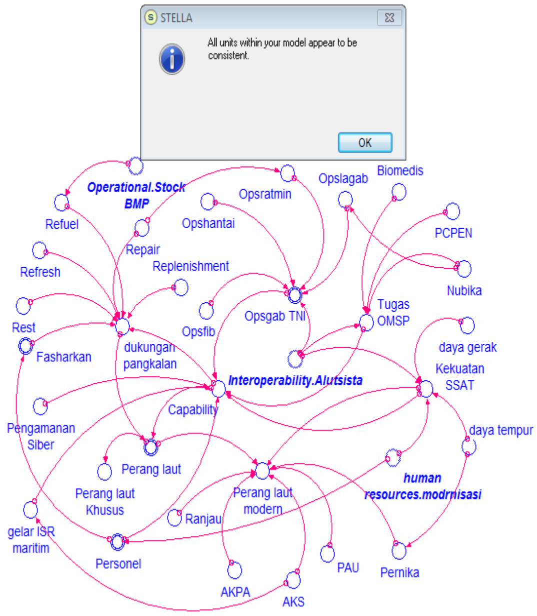

Figure 8. Sub Model Capability

3.8 Operational aspect

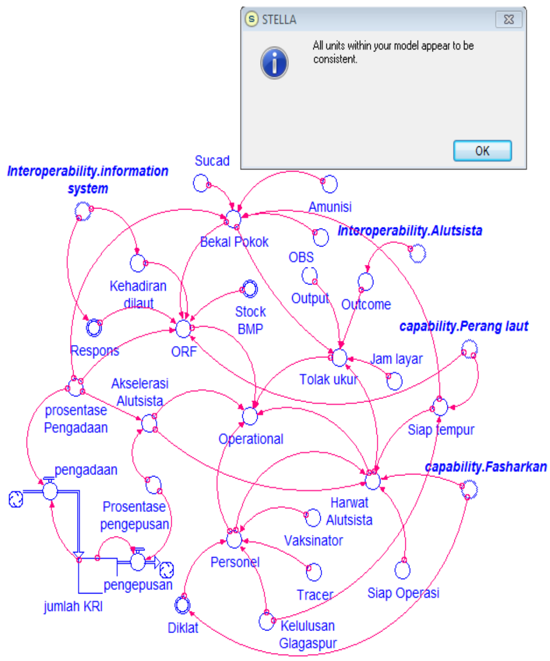

Figure 9. Sub Model Operational

Identified as a system for measuring the value of SSAT forces that are combat ready and operational for use by the commander. In this aspect, it is influenced by the success of operations based on outputs and outcomes, focus on maintenance and maintenance of defense equipment, acceleration of procurement and elimination of basic equipment supplies, stock of operational BMP needs, training and personnel graduation.

3.9 Formulasi

The model formulation is prepared by translating the stock flow diagram into a mathematical model with the basic assumption of a dynamic model in variable assessment.

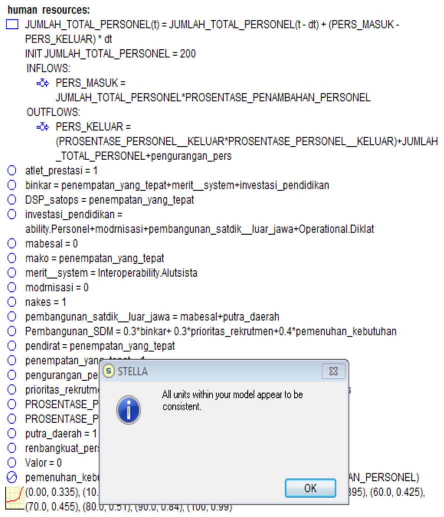

Figure 10. Equations.

4. CONCLUSION.

a. By understanding the CLD model system approach, it can be seen more clearly that the strategies and efforts to increase the strength of the Indonesian navy do not only pay attention to or focus on the continuity of internal and external aspects that are usually done but many things need to be considered carefully because each unit can influence each other or have an impact on one another.

b. Based on the results of the verification carried out on the STELLA software, the program will run without a hitch because all variables have the same unit parameters.

c. Based on the results of the validation carried out on the STELLA software, it can be seen that the model simulation parameters have run according to the actual logic.

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FIELD II
LOGISTIC MANAGEMENT

BUILD SAFE SECURITY SYSTEMS USING CODE, FINGER PRINTS, AND CAMERAS WITH KANSEI ENGINEERING METHOD

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ABSTRACT

The Financial Office of Koarmada II (Disku Koarmada II) has the ability to support the KRI oprasional or unit that is the demand of the Navy. To support the implementation of these tasks, the Koarmada II Financial Office needs to be equipped with special equipment to support the implementation of tasks in storing money and valuable state assets. IoT safe security system. That will monitor the security conditions in a storage is certainly very necessary for financial holders to be able to monitor the security conditions in the safe even remotely. Currently, The Financial Office of Koarmada II does not have a security system in the safe, in this study the author tried to design a security system with the Internet of things system, from the results of research on the entire system that works smoothly and the process of sending reports on accessing the safe to the mobile phone is very good. With this system, it is expected that financial holders can monitor through the application on the mobile phone if anyone accesses the safe, so as to prevent before the breach of the safe, even know if there are people who try to access the safe.From the existence of this security system will be able to complete the main tasks effectively and efficiently and able to minimize material losses.

Keywords : Kansei Engineering, Security Safe IoT system

1. Introduction

At this time the crime rate is increasing, especially theft cases that are increasingly rampant. The lack of prudence from humans as well as the lack of surveillance devices led to increased theft and the results of the search for evidence are often nil.But now technological advances also continue to grow rapidly, especially in the field of electronics. Brankas is a tool commonly used to store valuables so that a good security system is needed and an online monitoring device is needed to keep and know the condition of the safe remains safe.

The Indonesian Navy has an obligation to maintain sovereignty and security in the territorial waters of the Unitary State of the Republic of Indonesia, as for the additional task of the Navy itself, namely by carrying out the development of technology for the strength of the sea area, this case one of the tasks is to maintain important documents and state finances that will be held accountable, financial institutions in the Navy are held by a supply officer who has an obligation to support personnel, logistics and security and security documents. Therefore, a financial storage tool and documents are needed in order to support the implementation of soldier operations, with the importance of a storage tool that exists in the navy service environment, the author wants to create a safe security system to store and secure valuable documents with a high level of security in accordance with the development of current technology.

There is a problem that existed in the navy, namely in the task force or in kri about the storage of documents and money placed in an improper place resulting in material losses and hampered an operation. For example, in 2016 there was a safe break-in at the TNI Mabes resulting in the delay of an active support operation and also in 2018 there was a break-in at the Koarmada II Health Office.

With the current problems, there is an opportunity to develop an automated control system with remote security. To develop the control system, researchers named the IoT vault. This additional security equipment is controlled by using a mobile phone to see the safe condition of the material inside with the control process using the software contained in the safe, and the application system inside the mobile phone to report the access condition in the opening of the safe in real time. This tool also focuses on ergonomic products which become a very important part, both in terms of comfort and safety of the wearer, so that the role of IoT safe can support every operation carried out in the task force or KRI.

The research in this thesis is designed to create a safe by utilizing IoT (Internet of Thing) technology by using a small computer as a controller and sim800 as a modem so that this tool can continue online and send photos to mobile phones with the aim of monitoring the state of the safe.

When there is a mismatch of codes and fingerprints between the bangkas owner and others then the camera will automatically take a photo and send it to the owner's phone so that the owner knows who wants to access the safe, through the application on the mobile phone in real time so that the possibility of safe becomes safe.In this study the authors used the Kansei Engineering Method. In addition, the object studied is a financial storage tool and documents with the Navy. The selection of such methods is due to trying to translate the results of the psychological feelings of officers and soldiers in their duties to store valuable assets, and the security system equipment is also not in the navy task force

2. Library Overview

2.1 Previous Research

From some existing research it will be a comparison or benchmark in the manufacture of design tools that will be made by the author, so it will make it easier to know the shortcomings of the former and then developed according to the demands of the work, the author took some previous research as a reference in multiplying the study material. Here is a previous study in the form of several journals related to the research conducted.

2.2 Planning In Products

Product planning is the process of finding ideas from a product and carrying out several steps until the product can be used. In addition, it must have another strategy if the product fails in its manufacture.

Success depends on the ability to identify consumer needs, then continually create products that can meet those needs at a low cost. This is not the responsibility of the marketing department, in the development of products based on the request or requirements and specifications of the product by the user is a good enough step, because with the desire-based kosnumen then the possibility of the product is not accepted by the user.

There are 5 specific dimensions related to profit value and commonly used to assess business performance in product development, namely:

a. Product Quality

How well the product results from development efforts and can satisfy the needs of consumers. The quality of the goods will ultimately affect their use so as to determine the price that the user wants to pay

b. Product Cost

The cost for equipment and tool capital as well as the production cost of each unit is called the manufacturing cost of the product. Product costs determine how much profit is generated on a given sales volume and sales price

c. Product Development Time

Development time will determine the ability to compete, show responsiveness to technological changes and will ultimately determine the speed to receive economic returns from the efforts made by the development team.

d. Development Costs

Usually the cost of development is one of the very important components of the investment needed to achieve profit.

e. Development Capabilities.

Development capabilities are assets that companies can use to develop products more effectively and economically in the future.

2.3 Product Development

There are 3 stages of the process in the development of new products / services, namely:

a. Interesting Market (Need pull / market Pull)

From this point of view, we have to make what can be sold. So the new product is determined based on the needs of consumers. New product types are determined through research & customer feedback, with little attention to technological developments. Need Pull will lead to the formation of incremental innovation.

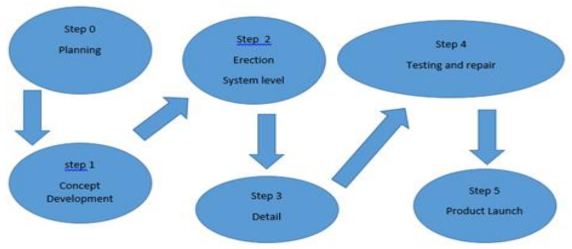
b. Pushing technology (Technology Push)

From this point of view it suggests we should sell what we can make. New products are obtained from production technology, the use of advanced technology and ease of operation, with little attention to the wearer. In other words, a new product or technology is encouraged or sold to a potential customer who does not request or know about the new product or technology. Technolgy Push will lead to radical innovation

c. Interfunctional

New products require cooperation between marketing, operations, engineering skills, and other functions so as to produce products that meet customer needs with the use of technology that provides the best benefits. For the success of innovation of new products or services required a combination of the first two models, namely the technical-linking and need-linking process. In addition, there are three elements that become considerant in creating new business opportunities, namely: relevant problems, technology sources and market demand.

According to Ulrich-Eppinger, (2001). The product development process generally goes through 6 tep, following Figure 1 six step in product development.



a. Step 0 : Product planning is an activity referred to as "zero phase" because this activity precedes the approval of the project and the process of launching the actual product development.

b. Step 1 : concept development phase, objective needs identified, alternative product concepts raised and evaluated, from one or more to concepts selected for development and experimentation

c. Step 2 : Phase System level design, this system includes product architecture definitions and product descriptions into subsystems and components

d. Step 3 : Detailed design phase design includes complete specifications of the shape, materials and tolerances of all unique components in the product and identification of all standard components purchased from suppliers.

e. Step 4 : Testing and repair phase testing and repair involves construction and evaluation of various early production versions of the product.

f. Step 5 : Initial Production In this phase the product is made using the actual production system. The target of this initial production is to train the workforce in solving problems that arise in the actual production process. The transition from initial production to actual production is usually step by step. At some point during this transition period, the product was launched and began to be made available for distribution

2.4 Questionnaire Creation

Questionnaires are some written questions that are used to obtain information from the respondent in the sense of reports about his or her personality, or things he or she wants to know. In survey research, the use of questionnaires is very important in data collection. The main purpose of questionnaire creation is to obtain information relevant to the purpose of the survey by filling out questions asked by researchers to the selected respondents. The requirements of filling out a questionnaire are questions should be clear and lead to research objectives (Ginting, 2010).

There are four main components of a questionnaire, namely:

a. The existence of subjects, namely individuals or institutions that carry out research.

b. The existence of an invitation, namely a request from the researcher to participate in actively and objectively fill in the questions and statements available.

c. The existence of questionnaire filling instructions, where the available instructions must be understood.

d. The existence of questions and statements along with the place to fill in the answers, either in private, semi-closed, or open. In creating this question is also included with the field for the identity of the respondent.

Questionnaires are tools that researchers use to collect primary data. The stages of questionnaire making are as follows (Wijaya, 2011):

a. Level of satisfaction. The questionnaires in this section are used to measure the level of satisfaction felt by consumers.

b. Level of importance. Questionnaires in this section are used to measure how important an attribute is.

c. The level of expectation. This questionnaire is used to measure the level of consumer expectations of attributes.

2.5 Validity Test

Validity tests are useful for measuring whether the questionnaire is stable, accurate and its elements are homogeneous. So that if the validity obtained is higher, then the results of the test are increasingly about the target and increasingly showing what should be shown

This validity test is conducted with internal validity, where the criteria used come from within the test tool itself and each item of each variable is correlated with the total value obtained from the low correlation coefficient and significant level, then the item in question is dropped, the significant level used is 5%. The calculation of correlation in each total variable using the formula of correlation technique "product moment" is formulated as follows:

$$r = \frac{N\left(\sum xy\right)-\left(\sum x \sum y\right)}{\left\{\left[N\sum x^2-\left(\sum x\right)^2\right]\left[N\sum y^2-\left(\sum y\right)^2\right]\right\}^{1/2}}$$

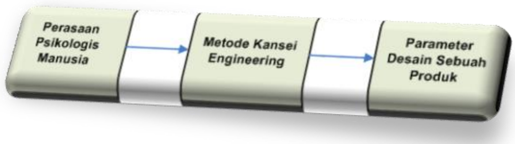
Where: : x = score each variable
y = total score of each respondent
N = number of respondents

Each variable that is hypothesized will be measured the correlation and compared to looking at the critical numbers. The way to view critical numbers is to look at row N-2 in the correlation table of the r value. In the implementation of data processing, to test the validity using SPSS software for Windows.

2.6 Reality Test

Reliability test used is one of them to see the level of consistency of respondents tehadap existing variables so that the data obtained will tend to give the same results (consistent)

As the formula for the variance coefficient (with Cronbrach) is:



Where α = Reliability coefficient

K = number of question items

$\sum \delta_b^2$ = Number of question items

δ_t^2 = Total varian

$$\alpha = \left[\frac{k}{(k-1)}\right]\left[1 - \frac{\sum \delta_b^2}{\delta_t^2}\right]$$

2.7 Prototyping

Prototype is the assessment of products through one or more dimensions (Ulrich and Eppinger, 2001). Prototypes are used for learning, communication, merging and as milestones. Some useful principles for guiding decisions about prototypes during product development, i.e. analytical prototypes are generally more flexible than physical prototypes. Physical prototypes are needed to detect unexpected phenomena, stages in prototyping:

a. Setting the goal of the prototype
b. Set the prototype forecast level
c. Outline a trial plan
d. Create acquisition, creation and testing schedules

After the prototype product is completed, a series of tests are carried out which include performance testing as well as mechanisms for the use of other functions of the product. This test will be conducted to see the results of the design according to what is expected and to compare whether the level of satisfaction with the use of the new product is better or not than before.

2.8 Kansei Engineering

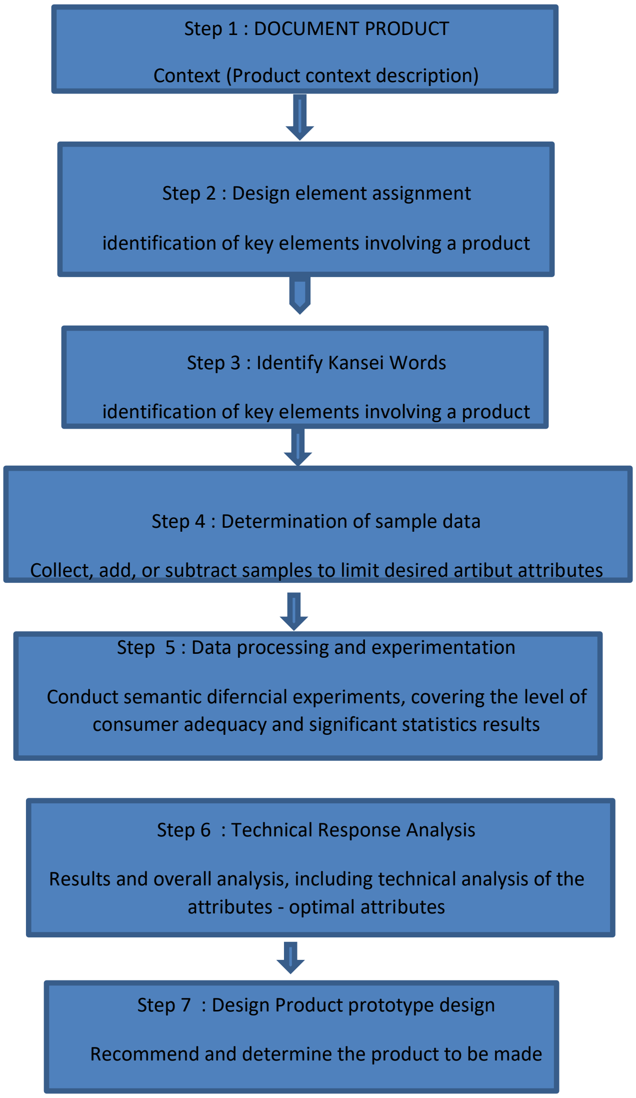
This method is the development or improvement of a product or service by translating psychological feelings and user needs into product design parameters. This method was first invented by Mitsuo Nagamachi (Nagamachi, 1995) as a new method of technicalization in the design and development of industrial products. The design parameters of this product as a reference for the industry to produce quality products with the right quantitative size of the production process

Kansei Engineering aims to produce new products based on customer feelings and demands. There are four items related to this technology, namely:

a. Understand customers' feelings about the product through ergonomic and psychological approach.
b. How to identify the design characteristics of a consumer kansei
c. How to build kansei engineering as an ergonomic technology.
d. How to adjust product design to the latest consumer changes to consumer preference trends.

Kansei Engineering collected words that represent the feelings of consumers are then selected to take the most relevant words. With regard to the second item, what is done is to conduct a survey or an experiment to find the relationship between kansei words and design elements. For the third item, advanced computers were used to develop the framework systematics of Kansei's engineering technology.

Kansei's method of getting reaction from consumers can be seen more clearly below,



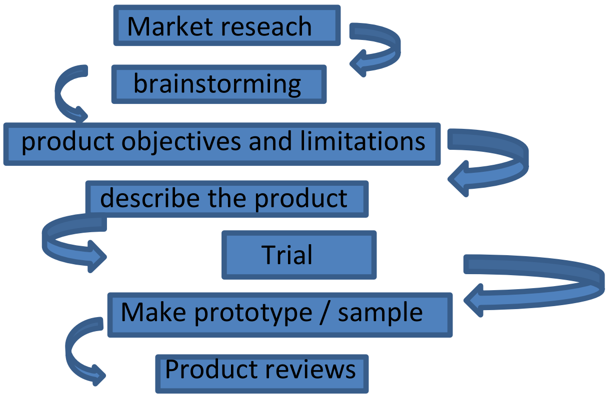
3. Research Methods

3.1 Research Design

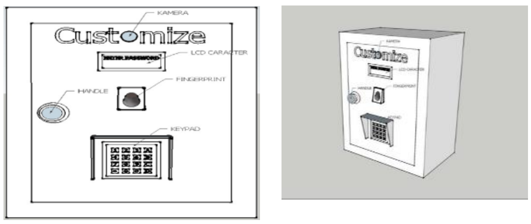
The research that will be conducted is applied research. this type of research was chosen because of the problems that exist in the Navy's work environment. This problem requires an element to find and follow a target in the processing of financial storage and documents in the task force, this research uses valuables and money storage tools in the form of safes with IoT systems..

3.1.1 Product Design

On this occasion the author will look at the needs of consumers, then precisely create the product as desired so that it can meet the needs at a low cost. To make a product will usually go through the following stages figure stage in the manufacture of the product.



The following is a safe design that the author later created to store valuable documents and money in the navy environment following figure of the IoT safe design.



3.1.2 Methodology

Methodology of the thesis report entitled "DESIGN SAFE SECURITY SYSTEM USING CODE, FINGERPRINT AND CAMERA WITH KANSEI ENGINEERING METHOD" based on IoT with the following steps

a. Literature Studies

To reinforce ideas and ideas, literature studies on sensors and microcontrollers were conducted. Literature used in the form of books, articles both from the internet and journals as well as research data and experiments that have been done before.

b. System Design

In this section the stages to perform the design of tools and systems include the design of systems in the form of hardware and software.

c. Hardware Creation

In this section the creation of each sensor node consisting of three sensors consists of a ph sensor module, a temperature sensor module, and a turbidity sensor module that will be integrated into the Arduino software creation In this section the software design stage consists of creating ESP8266 as Arduino's link with the local network, Arduino IDE as a C language writing program to program and configure the microcontroller then PHP is used to establish a connection with the sensor database.

d. Assembly of All System Components

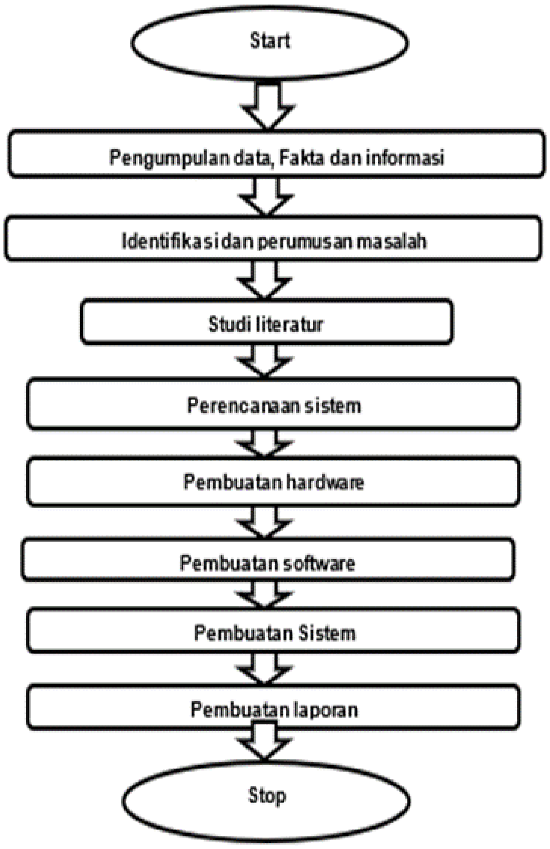
Once all the required components are available, then the next step is the process of assembling the components, making sure all the components that have been assembled work properly.

e. System Testers

This test is designed to know that the performance of each system from the results of the manufacture of hardware and software as expected. The testing phase includes testing per block and testing throughout the system. Testers per block are conducted to determine if the system is as planned.

f. Report Creation

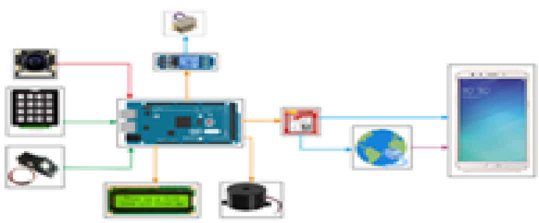
Report creation is done after all stages are completed so that the results obtained from the creation of the system are explained in detail according to the data obtained following is a research flowchat.



4. Data Analysis and Discussion

In the discussion of this chapter is the collection and processing of data using kansei engineering method that is directly related to the initial condition of the research object. Furthermore, the data will be processed to produce the design of the existing initial conditions, both in the form of design and additional functions that can be used at the time of product manufacture.

Here is figure of the comparison of the safe used by koarmada II financial office with the IoT safe that the author later created.



From the comparison, the old safe only uses a code to open, while the IoT safe uses fingerprints and 6 codes and a camera that is entirely connected to the Internet, so that access activities are immediately reported on the owner's mobile phone.

There is some data needed in this study, which is obtained based on the results of p engamatan and interviews directly as well as the results of field studies and libraries. here's Figure of the IoT System which illustrates the mechanism of action of the system.

On IoT systems this tool has two security systems. The first uses a fingerprint or commonly called a fingerprint sensor, where the sensor reads the texture or characteristics of the user's fingerprint, and is converted into values that are then processed so that the output is a match of fingerprint data with the user. Security of the next layer of this system using the keypad dimana pengguna memasukkan kode kombinasi angka through the keypad. the way the keypad works is to input digital data on the microcontroller which will later be converted into a number code. From the data the number code will be compared with the number code that has been stored so that it will be obtained the result of the conformity of the code entered with the previously stored code.

From the two security systems will be grouped into two decisions that are appropriate and not. If the result is not correct then the camera placed on the safe door will take a picture and be sent on the user's phone as well as a notification of the attempted break-in of the safe.

the results of both layers of security are appropriate then the solenoid that serves to lock the safe will open so that the user can open the safe door and use it. In this case a notification will also be sent to the user's phone.

In this system using two types of data communication, namely sms gateway and internet. To speed up communication with mobile phone users of this system use sms gateway to send notifications. As for sending captured images from the camera, the system uses the internet. On the safe door there is also an LCD character as an interface between the user and the safe. On this system also allows the user to reset the password as well as determine the master password. Master password is an alternative number code that can be used if the user forgets the previously saved password.

If the whole system works properly from the beginning to insert fingerprints, codes and modems that directly send a notification over the internet to the mobile phone then the Iot safe is perfect, and vice versa in case of network interruptions then the process of using the safe can not be used.

4.1 Determination of The Number of Questionnaire Data Samples

Data collection from the user is done using questionnaire method, which is filled by officers and members and civil servants Denma and Disku Koarmada II, often carrying out financial support to KRI or other units in the wall (questionnaire attached to attachment IV). the following is a recap of the number of financial members of Disku Koarmada II
From the data above the population is 124 people. To obtain the minimum sample count by using the Slovin formula (1998).

$n = N / N.d^2 + 1$ Where n = Number of samples

N = Population

d^2 = Precision set

The research population as mentioned earlier is 124 people (Officers and members of Denma and Disku Kormada II), the level of precision set by = 5% then the n value can be searched:

$$
\begin{aligned}
n &= N/N.d^2 + 1 \\
&= 124 / (124).(0,05)^2 + 1 \\
&= 124 / 1,31 \\
&= 94.65 \approx 95 \text{ People}
\end{aligned}
$$

Next will be calculated the spread of questionnaires on each Unit . The distribution of questionnaires is carried out based on a proportionate proportion of the population.

It can be concluded that the minimum sample number is 95 respondents. Questionnaires will be distributed to officers and financial members consisting of:

No	Kesatuan	N.	Proporsi N.	sebaran n.
1	KUWIL	27	0.22	21
2	MAKO	28	0.23	22
3	AKUN I	27	0.22	21
4	AKUN II	28	0.23	22
5	AKUN DENMA	14	0.10	9
	Σ	124	1.00	95

1. KUWIL = 21 People
2. MAKO = 22 People
3. AKUN I = 21 People
4. AKUN II = 22 People
5. AKUN DENMA = 9 People

4.1.2 Questionnaire Data Collection

The filled questionnaires are then reassembled to recap the results and graphed for easy understanding. The result is as follows figure respoden rank chart, Figure Old Service Chart, Figure Assignment Frequency Chart, table rank of respondents members, civil servants and officers, table length of respondents in Koarmada II, table frequency of assignment of members & officers and civil servants, and table the need for the development of IoT safe security system.

a. Rank of Respondent

Table 4.6 Pangkat Responden Anggota.Pns dan Perwira

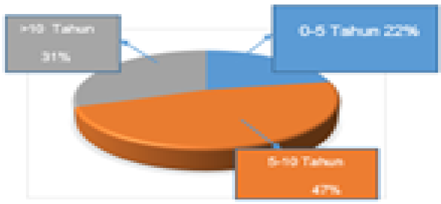
Perwira	Bintara	Tamtama	Pns
9	25	51	10

b. Figure Old Service Chart

Table 4.7 Lama Kedinasan Responden di Koarmada

0 – 5 Tahun	5 – 10 Tahun	>10 Tahun
21	45	29

(Sumber Olah Data)

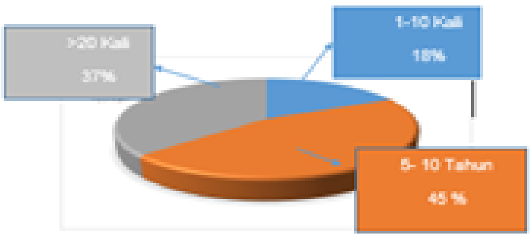


Long-standing responden in The Financial Office of Koarmada II

c. Frequency of assignment

Table 4.8 Frekuensi Penugasan Anggota & PWA Disku Armada serta Pns

1 – 10 kali	10 – 20 kali	>20 kali
17	43	35



d. The need for the development of IoT Table System Vaults The need for the development of IoT Safe Security Systems

From the questionnaire data collected graph images above the need for the development of the tool states that 100% of respondents from officers and members and civil servants Denma, Disku Koarmada II supports for the development of a safe product using IoT.

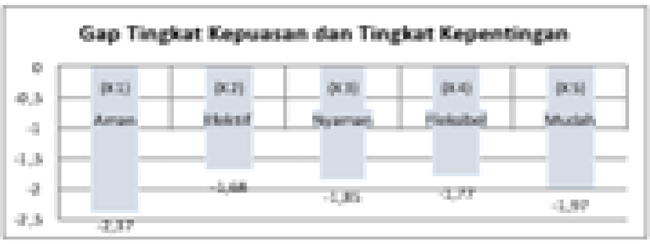
4.1.6 Interpretation of Questionnaire Data

From the questionnaire data obtained, it can be known the average level of satisfaction (listed in attachment VI) and the level of importance (listed in appendix VII) of the user against the desire needed to safe the IoT security system. Then it is necessary to do the interpretation of questionnaire data to get things related to the needs of the user in the assignment. As from the results of the interview that produced kansei words that were translated into variable form that suits the desired needs of members and officers of the Navy supply corps.

There fore, it is necessary to calculate the difference in the satisfaction level of the system or tools that already exist in Disku Koarmada II, with the level of importance of the tool that should exist. This calculation is present in each of these variables. Here's table on Average satisfaction levels and importance levels from questionnaire results and figure graphs of gab satisfaction levels and importance levels.

Table 4.10 Rata-rata Tingkat Kepuasan dan Tingkat Kepentingan

Variabel	[illegible] (X1)	[illegible] (X2)	[illegible] (X3)	[illegible] (X4)	[illegible] (X5)
Kepuasan	1.76	2.17	2.06	1.99	1.72
Kepentingan	4.13	3.85	3.91	3.76	3.69
GAP	-2.37	-1.68	-1.85	-1.77	-1.97



Gambar 4.7 Grafik Gab Tingkat Kepuasan Dan Tingkat Kepentingan

The data above can be known that there is a gap between the satisfaction level of the system and existing tools with the level of interest esired by the user. The highest gap is in the security variable (X1), meaning that the security variable becomes a priority demand that must take precedence in the assignment in the wall, so the expectation of an IoT safe security system tool is very expected

4.1.7 Determination of Order of Interest

By looking at the importance level data of each variable, it can be sorted what variable factors are the priority of product development. Table below shows the order of importance levels of ioT security system safe tool variables for officers and members level of importance

Table 4.11 Urutan Tingkat Kepentingan

[illegible]	[illegible]				
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RATA-RATA	4.13	3.85	3.91	3.76	3.69
URUTAN KEPENTINGAN	1	3	2	4	5

(Sumber Olah Data)

From the data table above it can be known that the order of the first level of importance is the safety factor, the second the comfort factor, the three effective factors, the four flexibility factors, and the fifth the ease factor. So that by knowing the order of importance level, it can be made a priority scale for the manufacture of a product.

4.1.8 Validity Test

Validity is a measure that indicates the validity or validity of an instrument. So the validity test refers to the extent to which an instrument performs a function. Instrument is said to be valid if the instrument can be used to measure what to measure (Sugiyono, 2006). Validity tests are useful for measuring whether the questionnaire is stable, accurate and its elements are homogeneous. If the validity obtained is higher, then the test is increasingly about the target and increasingly showing what should be shown. Perhitungan spss for Windows software with the following steps

a. Enter questionnaire data on satisfaction and importance levels as well as total scores.

b. Fillinganalyze correlativebivariate

c. .Then enter all variables and click OK

Satisfaction level validity test table, If r_{Count}> r_{table}, Then the variable is valid. With known value r_{table} = 0,202

From the results of the calculation using SPSS software, and looking at the results about the validity test of the level of interest, it can be concluded that rhitung> rtable, which means the data of the importance-level questionnaire is valid.

.Of all the variables at the satisfaction level as well as the level of importance, and meet the validity test, so that the questionnaire can be declared valid.

4.1.9 Reliability Test

The reliability of a measuring instrument is the determination or ability of the tool in measuring what it measures. That is, whenever the measuring instrument is used will give the same measuring result Reliability tests are used to see the level of consistency of respondents with existing variables so that the data obtained will tend to give the same results (consistent).

To do this test used SPSS software for windows, by using the following steps:

a. Enter attribute data into the SPSS software, only for valid variables.

b. Click analyse scale reliability analysis enter all OK variables.

c. If cronbach's alpha value > 0.6 then reliable. Here table is the result of reliability test of satisfaction level

Table Reliability Test Results Satisfaction Level

Case Processing Summary

		N	%
Cases	Valid	95	100,0
	Excluded[a]	0	,0
	Total	95	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,626	5

Case Processing Summary

		N	%
Cases	Valid	95	100,0
	Excluded[a]	0	,0
	Total	95	100,0

a. Listwise deletion based on all variables in the procedure.

As for the Importance Reliability Test is in table follows Importance Reliability Test Results

Reliability Statistics

Cronbach's Alpha	N of Items
.608	5

From the recap data table above it turns out that cronbach's Alpha value for satisfaction level is 0.626 and Cronbach's Alpha value for importance level is 0.608. And this is greater than 0.6 so it can be concluded that the data is Reliable. This means that the consistency level of respondents with existing variables indicates that the data source obtained will tend to give the same (consistent) results.

4.2.0 Component Selection

Selection of components is required for the design of safe security system tools based on the priorities required in the Department of Finance. In the selection of components all technical responses that become a priority are drafted so that later will be selected one component that best suits the desired needs. The following table shows a comparison of the components to be used in the creation of IoT safe system tools

While the column on the block in yellow is the component chosen because it has advantages and is best suited to the need for financial security in the safe.

No	Jenis Komponen	Komponen Pembanding		
1.	Modul Komunikasi	SIM 800L	Modem Wavecom	SIM 900L
2.	Microcontroller	Arduino Uno	Arduino Nano	Arduino Mega
3.	Power Supply	5v 3A	12v 5A	24v 5A
4.	Baterai	Lithium Ion	Lithium Polimer	Ni-Cd
5.	Modul Camera	VC0706	OV5642	OV7670
6.	Sensor Sidik Jari	FPM10A	5100 SDK	ZFM208SA
7.	Display	Alpanumeric LCD	LCD TFT	LCD OLED

Among the alternative components that exist then selected components that suit the needs of the tool are:

a. The communication module used is SIM800L. this module has smaller dimensions compared to other comparator communication modules. This module is quite efficient with a supply of 3.3V. features in this module are quite used in this tool.

b. The microcontrollers used are two Arduino Megas. Arduino Mega has a larger memory compared to other microcontrollers. It also requires a lot of GPIO to access all the pheriperals on this tool such as Sim 800L, Camera, MicroSD Module, Keypad, Fingerprint etc.

c. Power Supply used is 12v 5a where the power supply is enough to cover all the needs of components in this tool. It also comes with a 5v and 3.3v regulator to supply each component

d. The battery used is a type of Li-Po 3s 1100 MAh battery. This battery is used to temporarily replace PLN power when pln power goes out so that it remains safe even if the power goes out.

e. The camera module used is type VC0706 because this type of camera can be processed faster compared to other cameras. The camera uses serial communication with its microcontroller.

f. The fingerprint sensor used is ZFM208SA where it is highly compatible with Arduino controllers.

4.2.1 Prototype Testing

After selecting the components of the safety device safe, the assembly of the components is carried out and obtained the results as shown below.

(A) Tampak Depan (B) Tampak Dalam (C) Tampak Samping

Design testing is done after the tool is finished. Testing is performed to see if the tool is working properly or not. Tests were also conducted to determine the durability of the device. The tool has been operating for more than 500 hours non-stop in standby mode to test which parts of the hardware are weak.

As for the operation of the tool has been done more than 100 times to test the locking mechanics whether it can survive or not. The following figure 4.7 safe in an off state is documentation of the testing tools that have been performed:

Figure Safe Off (Data Processing Source)

Once the appliance is turned on the system will prepare all the sensors and components used. The following image of the boot system is the display displayed on the LCD.

(A) Layar On (B) Layar Siap Input Data (C) Sidik Jari

After boot mode is complete, the safe in standby mode (on) where the lcd lamp is off and the fingerprint lamp remains on.

Figure Safe in Standby Mode (on)

In standby mode the safe can be operated by pressing one of the keys on the keypad. the following enabling safes from standby mode is testing the operation of the safe.

Once the safe is active, the LCD will display as follows figure display on the LCD when fingerprint instruction

(A) LCD Siap (B) Masukkan Sidik Jari

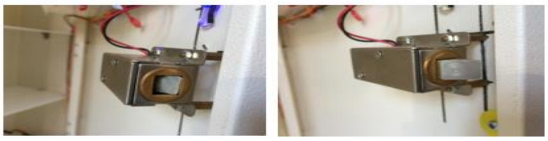
.When the user puts his finger on the fingerprint sensor there are two possibilities that the fingerprint is detected correctly (according to registration) or wrong. Hereis the result of fingerprint sensor testing. If the sensor detects that the fingerprint is correct (according to the registration data). So in figures system will ask for a number password.

Figure Number Password Requesting System

At this stage also the user will get two possibilities, namely true or false passwords. If the password is correct then the safe will open and the system will send a notification on the android applicationIf at the stage of entering the fingerprint or password the user's number makes an error three times then the system will automatically capture the user and the image can be seen on the android application. The system also closes safe access for 5 minutes Solenoid condition when opening.

Gambar 4.22 Notifikasi Pada Aplikasi Android Saat Brankas Berhasil Dibuka
(Sumber Olah Data)

Gambar 4.23 Notifikasi Pada Aplikasi Android Saat Brankas Tidak Berhasil Dibuka
(Sumber Olah Data)



Gambar 4.18 Kondisi Solenoid Saat Membuka dan Menutup

Gambar 4.19 Prototype Dalam Brankas
(Sumber Olah Data)

After we did the exposure about this tool, we also did a data retrieval using a questionnaire. This is to get the level of need of this tool. Here are pictures of Data Retrieval Documentation Using Questionnaires at Koarmada II Financial Office.

There are some drawbacks to this safe security tool, some fundamental drawbacks are in the long process such as shooting, storing on sd card module memory until it is sent to the hosting server takes up to 20 seconds. And another drawback is that no effort can be made if the safe is moved because the safe is not accompanied by a Location tracker such as a GPS tracker system, .the advantage of this safe tool with IoT system is that we can find out who will access the safe if there is an error three times entering the fingerprint then automatically the camera will immediately photograph and send through the safe holder's mobile phone, so that the identity of the person can be immediately known.

There are several important elements considered in making this product, namely ease of use, effectiveness, safety, and ergonomic design. Ease of use requires that this product be used by all users or sections on duty. Effectiveness requires that no wasted parts be attached to this tool. All parts are interconnected and supportive in the running of this tool. Security is the main point in the creation of this tool, where the function of this tool is to secure what is inside. Safety in terms of mechanics, systems and electricity. .The ergoononic design relates to the user's comfort in operating this tool. This tool is designed as simple as possible as a design.

5 Conclusion

Some things that can be inferred from this final task are as follows:

a. The author designed and made the tool effectively and efficiently and has ergonomic value to be easy to use in the task in accordance with the demands of technology and high security value, then the author tests the tool on parts of the Internet System in the safe and applications on the android is functioning well and smoothly.

b. The author tests the code that has been entered by six numbers and inserts three fingerprints whether it can function properly or not, then tests the camera that is already installed in the safe, from the test results that all the tools work well without any constraints.

c. For the results of the performance of this IoT system safe tool, the entire system works very well starting from inserting fingerprints, codes, cameras and internet modems in it, so that the safe can be monitored through android applications on the phone in real time

d. With the code system, fingerprints and cameras as well as android applications made for security, then in the problem of safe break-ins during this time will be solved. With this IoT system vault then we will get clear information in real time ownership of the safe, so it is very profitable for its users.

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FEASIBILITY STUDY OF OZONE GENERATOR BASED ON HIGH VOLTAGE ELECTRODE METHOD

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ABSTRACT

Currently, various technologies are being developed which aim to improve the oxidation process so that its pollutant byproducts can be reduced. One of them is the development of the use of ozone as an alternative oxidizer which in the organic chemistry perspective has more free electrons so it is more reactive than oxygen. Ozone can be produced through several methods, such as the electrolysis method, the incandescent electrode method and the high voltage electrode method. This study aims to measure the feasibility of an ozone-producing reactor based on the high-voltage electrode method to produce photon strips initiating the formation of oxygen radicals. As the main indicators of the feasibility is the efficiency and level of performance of the reactor in producing ozone. As a comparison, the reactor is based on the previously made incandescent electrode method. Based on data from experimental results in the laboratory it can be shown that the high voltage method reactor is quite feasible. It can be proven in the discussion and analysis using linear regression and Minitab software that this method provides an increase in efficiency of 0.5% (0.714% to 1.214%) and an increase in performance of 1.8 ppm / min (2.57 ppm / min to 4, 37 ppm / minute ozone gas can be produced from 2.4 L / min of atmospheric air flowed into the reactor tube).

Keywords: *Laboratory Experiment, Application, ASTM D-2912, Linear Regression and Minitab Software, Product Feasibility.*

1. INTRODUCTION.

Today there have been found various forms of new technology, both in the form of refinements of old technology and forms of technology that are truly new. Various technological innovations carried out in the industrial world. For example, incomplete combustion flue gas management technologies, such as CO and HC. Hydrocarbon combustion involves oxidation by oxygen. Some literature states that ozone is more reactive than oxygen as an oxidizer. For example, oxidation of potassium iodide. At room temperature oxygen slowly reacts with potassium iodide, but ozone forms iodine more quickly.

Research on ozone reactors based on incandescent electrodes and their use as oxidizing agents has proven to be more efficient and performance has improved, but it has not been significant. More innovation is needed, such as the use of other methods to produce ozone.

Based on the background and problems, the purpose of this research is to conduct a feasibility study of reactors based on other than incandescent electrode methods, namely reactors based on high voltage methods. Avoiding the complexity of the problem, this paper is limited to:

1. Analyze the effect of high voltage electrodes on reactor performance.
2. Thermodynamic aspects are used as a reference, but not discussed.
3. Results of the study only apply to the specifications of the method being carried out.

The research method used in principle is in accordance with previous scientific methods, as follows:

1. Manufacture of ozone reactors.

2. Research and testing of ozone reactors using spectropometric methods.
3. Data analysis and conclusion making using Linear Regression and data processing with Minitab.

2. MATERIALS/ METHODOLOGY

2.1. Ozone Characteristics

Ozone (O_3) is a compound composed of three oxygen atoms, the molecule is symmetric at an angle of 117ºC. The chemical bonds are single bonds and double bonds where a pair of oxygen atoms form a double bond and the rest of the electrons are used to bind to other oxygen atoms, consequently the last oxygen atom is surrounded by free electrons which makes this ozone molecule very reactive because it resonates.

Like oxygen, ozone is also an oxidizing compound so that its reactivity can be evaluated in terms of its ability to oxidize a substance. The level of ozone reactivity can be demonstrated by comparing it with oxygen in oxidation reactions. For example the reaction to the potassium iodide solution below,

$$6\,KI_{(aq)} + O_{3(g)} \xrightarrow{20^\circ C} 3\,K_2O_{(aq)} + 3\,I_{2(g)}$$

$$4\,KI_{(aq)} + O_{2(g)} \xrightarrow{20^\circ C} 2\,K_2O_{(aq)} + 2\,I_{2(g)}$$

In a relatively short time ozone can oxidize potassium iodide to form iodine by changing the color of the solution from yellowish to reddish. Whereas oxygen can oxidize KI to show the same symptoms takes a long time, even days.

The reactivity levels of ozone from the energy spectra are as follows:

$$O_{2(g)} + 4H^+(10^{-7}M) + 4e = 2\,H_2O_{(aq)} \qquad E^o = +0{,}815\ \text{Volt}$$

$$O_{3(g)} + 2H^+(10^{-7}M) + 2e = O_{2(g)} + H_2O_{(aq)} \qquad E^o = +1{,}65\ \text{Volt}$$

Potential energy shows in ordinary aqua solutions having a difference of 0.835 volts. So from the two evidences above it can be said that ozone is far more reactive than ordinary oxygen.

Ozone in the natural gas phase is colorless, pungent. At a temperature of -111ºC it melts in blue. and solidify at a temperature of -192ºC to turn blackish blue. In this condition ozone has toxic properties over KCN or NaCN, stricture and carbon monoxide. Ozone toxins in plants cause slowing of growth at 30 ppb levels. At levels of 150 ppb to 300 ppb, humans experience throat irritation and asthma attacks.

2.2. The Mechanism Of The Formation Of Ozone In Nature.

Ozone is abundant in the stratosphere, which is 30 km from the earth, which is a cloudless and stable layer because there is no vertical air circulation. In the ultraviolet light Stratosphere, the wavelengths are short and high-energy are optimally absorbed by free oxygen to form oxygen radicals. Reactive oxygen radicals join the remaining O_2 molecule, forming O_3. In the lower, cloudy and unstable layers of the atmosphere, ozone is formed by the presence of free voltage from differences in charge accumulated and polished from moist clouds that generate high electrical energy. So in principle ozone is made by giving high energy to oxygen. The reactions that occur are

$$O_{2(g)} \xrightarrow{UV\,(220\text{–}230nm)} 2\,O\bullet$$

$$O\bullet + O_{2(g)} + M_{(g)} \xrightarrow{radiasi} O_{3(g)} + M_{(g)}$$

M is a third particle such as nitrogen or other molecules in the atmosphere. The third molecule is not a condition for the formation of O_3 but because the process in the wild this third molecule also absorbs some of the radiation energy that is useful to increase the life of unstable O_3.

Radical oxygen in nature is very unstable, to prove its existence can be done in the laboratory in the following ways:

a. Chemical method

This method is based on the characteristics of highly reactive radical molecules, which provide a reactant to be reacted with these radicals to form a more stable product, then carry out isolation and identification.

b. Spectroscopic method

This method utilizes the change in electronic energy levels in radicals when reacting with a reactant compound, in the same way with the previous method then identified by the spectroscopic method.

c. Sophisticated methods

Sophisticated methods for identifying radical molecules present in a solution are the SER (Spin Electron Resonance) method and the CIDNP (Chemically Induced Dynamic Nuclear Polarization) method. The final method of CIDNP is a method that utilizes the effect of chemicals (in this case, the chemicals being tested) on the dynamics of core polarization.

2.3. Ozone Making in Laboratory

Adopting the ozone formation process in nature, modifications can be made in the laboratory by the following methods:

2.3.1. Electrolysis Method

This method uses a reactor that works by electrolysis. The electrodes are fluorocarbons, while the electrolyte solution used is HBF_4, H_3PO_4. The products of this process are water vapor, oxygen and ozone. Efficiency obtained by 35% with a temperature condition of 10^{o}C with 48% weight / volume HBF_4 at 400mA cm-2. This method needs aeration in the anode because it can explode, resulting in an efficiency of 15%]. The reaction is.

$$2H_2O_{(aq)} - 4e^- \longrightarrow O_{2\,(g)} + 4\,H^+_{(aq)} \qquad E^o = 1{,}23\ V$$

$$O_{2(g)} + H_2O_{(aq)} - 2e^- \longrightarrow O_{3\,(g)} + 2\,H^+_{(aq)} \qquad E^o = 2{,}07\ V$$

2.3.2. Incandescent Electrode Method

This method uses electric sparks, the reactor is in the form of tubes and electrode circuits with a voltage of ± 7.5 kV. The working principle of this method is based on the formation of ozone in nature by lightning, which utilizes electric sparks to form oxygen radicals that will react with oxygen compounds to form ozone.

The energy generated depends on the frequency of fire formation, and is directly proportional to the formation of oxygen radicals and the levels of ozone that are formed. CDI (Capacitor Discharge Ignition) as a frequency regulator. The transformer to increase the voltage from 220 V to 400 V back and forth is then changed by leveling into a direct current that passes through the coil or series of diodes and the condenser forms a 7.5 kV system. The flow of the gradual grader becomes the initiator of the ozone formation process.

In incandescent electrode-based ozone generators obtained efficiency of 0.714%. The value is obtained by flowing air containing 21% oxygen into the reactor at a speed of 2.4 L/minute, then the oxygen absorbed every minute is 0.504 L. That amount is equivalent to 360 mg/ L or 360 ppm.

2.3.3. High Voltage Electrode Method

This method uses high voltage to convert oxygen to ozone-forming free radicals. The high potential difference between the two electrodes makes the electrons detach from the surface of the cathode with a certain energy. This electron discharge is called a photon. The energy is formulated by Planck as follows:

$$E = n\,h\,v = n\,h\,c / \lambda \qquad (1)$$

Information :

E = energy

h = Planck constant (6.624 x 10-34 j.dt)

v = photon frequency

c = speed of light

λ = photon wavelength

n = mole of photons

Energy (E) hits electrons in O_2 double bonds and is able to break the double bonds to form free radicals that are reactive to O_2 to form O_3.

The most important parts of this high voltage method are the high voltage generator circuit, the electrodes and the reactor tube. High voltage generator circuits that are often used are as below

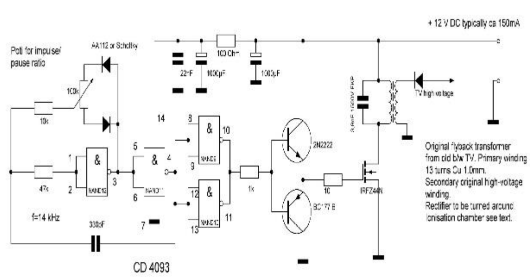

Figure 2.1. High voltage generator circuit

The combination of electronic components such as diodes, transistors, oscillators and voltage multiplier transformers or in the form of a coil. With a voltage of 20 kV electrodes of any type of metal will produce electron discharges.

The electrode is a very important part in producing the photons needed to break the O_2 double bond. The different types of electrodes will provide a difference in the price of heat conductivity and the difference in the price of heat conductivity gives a difference in the ability to move and release electrons. Metals that have high heat conductivity usually have a large atomic number, because the greater the atomic number, the more inclined the atom tends to mobilize its outer electrons and the greater the heat conductivity of course the smaller the obstacle. According to the above understanding, it can be seen the effect of the size of the resistance of a type of electrode on the amount of energy to mobilize or release electrons. So examples of metals that meet the above requirements are copper, aluminum, tungsten.

The amount of photon energy that arises from a metal electrode can be determined by equations (2) and (3),

$$V = i\,R \qquad (2)$$

$$E = V\,i\,t = (V2 / R)\,t \qquad (3)$$

Information :

V = potential difference, in volts (V)

i = current in amperes (A)

R = resistance in ohms

E = electrical energy in units of watt seconds

t = time, duration of current flowing

The next important part is the reactor tube. In principle, the tube has room for collisions between bonding electrons and photons and meets the design requirements in the optimization of ozone production. Including controlled room temperature and pressure so that the volume of air containing oxygen involved in the ozonation process can be known with certainty, this is needed to determine efficiency.

The next important part is the reactor tube. In principle, the tube has room for collisions between bonding electrons and photons and meets the design requirements in the optimization of ozone production. Including controlled room temperature and pressure

so that the volume of air containing oxygen involved in the ozonation process can be known with certainty, this is needed to determine efficiency.

The reactor tube must be made of good insulating material, because in it there are high-voltage electrodes which can endanger the life of the tool user. Examples of good insulators are polymers such as PVC or ceramics.

The preparation of electrodes in the reactor is directly related to the optimization of the reaction. The position between the cathode and anode is directly related to the quantity of photons emitted. The electrode cross-sectional area also influences the quantity of photon discharge, the greater the cathode surface area, the greater the quantity of photons emitted. Then the cylindrical tube-shaped cathode was chosen because it had a wider surface than the rectangular bias. The cylindrical stick anode will cover the entire reactor tube so the percentage of collisions between photons and oxygen passing through the tube will be high. Like the design drawings below

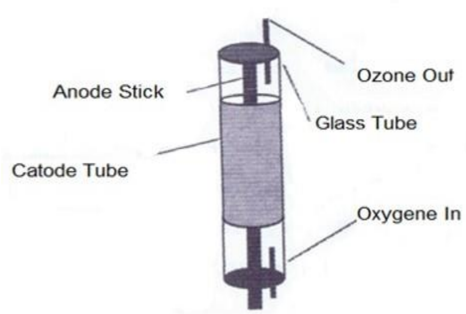

Figure 2.2. Reactor tube Model.

2.4. Ozone Forming Energy

Oxygen turns into ozone, needs energy of + 285 kJ/mol. Petrucci revealed the following stages:

$$O_2 + hv \rightarrow O + O$$
$$O_2 + O \rightarrow O_3 + E$$

The energy needed to separate O atoms from O_2, break O=O double bonds and form 2 radicals is greater than hv (O_2 bond dissociation energy), which is 494 kJ/mol. Thus, a high voltage generator in an ozone producing reactor must be able to emit 1 mole of photons with a total energy of at least 494 kJ / mol, or 1 photon particle with an energy of $0.821.10^{-18}$ Joules. Following equation (1), it can be assumed to satisfy the energy above the minimum λ that a photon particle must have at 242.30 nm.

2.5. Stoichiometry of Oxygen and Ozone Radical Formation Reactions

This is the stoichiometry of the O=O double bond termination reaction to form the O radical, by irradiating the O_2 molecule with a photon with a wavelength of 242.3 nm.

In this calculation, the principle is to equate the number of moles of O_2 with the number of moles of photons. To determine the number of moles of oxygen passing, you can see the ideal gas equation below:

$$P\,V = n\,R\,T \qquad (4)$$

Information :

P = gas pressure, in the atmosphere (atm)

V = gas volume (reactor tube volume), in liters (L)

n = gas mole

R = ideal gas constant = 0.082057 atm / mol.K

T = gas temperature in the reactor tube, in Kelvin (K)

Meanwhile, to determine the number of moles of photons can be determined by the Planck equation as in equation (1) above. Equations (1) and (4) can be substituted, so that the following equation is obtained:

$$P\,V / R\,T = E / hv \qquad (5)$$

then by combining equation (3) with equation (5) the equation below is obtained,

$$P V / R T = vit / hv \quad (6)$$

Thus if the values of P, V, T are known then we can adjust the variables v, I and t to be able to determine the same mole price of oxygen and photons, because the λ is known, which is 242.3 nm.

Theoretically, if a photon mole is equivalent to a mole of oxygen then 100% O_2 will split into free radicals, then the calculation of the efficiency of the reactor will be optimal if the number of moles of photons is 1/3 of a mole of oxygen, assuming each radical is precisely paired with one O_2 molecule to form O_3.

2.6. Spectrophotometry Theory

Spectrophotometry is an analytical method based on the interaction of electromagnetic waves on the material being analyzed. This method is used for analysis of chemicals that have relatively low concentrations. The instrument used is called a spectrophotometer. A standard spectrophotometer consists of a spectrometer to produce light with a selected wavelength (monochromatic) and a photometer which is a device for measuring the intensity of the selected light.

An electromagnetic wave has an energy called a photon energy, and the magnitude of the photon energy can be determined through equation (1). Photons with certain energy can be collided with the material will cause the transfer of atomic energy levels from the material. Each type of atom has different energy levels so that the transfer of energy levels that occur also varies. From the difference in the transfer of energy levels obtained differences in the spectrum of electromagnetic waves that are transmitted and absorbed or reflected and polished by matter. This is the main basis for identification. This law is known as the Lambert-Beer law.

2.6.1. Lambert-Beer Law

Briefly by Lambert-Beer, it is explained that if a beam of light passes through a homogeneous medium, then part of the incoming ray (Po) is absorbed as much as Pa and reflected as much as Pr (then the value is assumed to be 0 because the magnitude is below 4%) and continued as Pt, which can be formed in the equation below,

$$Po = Pa + Pt \quad (7)$$

After being given input by Bougar the equation was developed into an equation which became the working principle of the UV (Ultra Violet) spectrophotometer and looked, as follows:

$$T = 10^{-abc} \quad (8)$$

$$\mathrm{Log}T = \mathrm{Log}\,(Pt/Po) = -abc \quad (9)$$

$$\mathrm{Log}(1/T) = \log(Po/Pt) = abc \quad (10)$$

$$A = abc \quad (11)$$

Where T is Transmittance, A is Absorbance and a is the absorptivity constant and b is the optical distance and c is the concentration of the substance being analyzed.

2.6.2. Legality of Lambert-Beer-Bougar Law

There are several conditions which are the conditions for the entry into force of the Lambert-Beer-Bougar law, namely:

i. The light used must be monochromatic. If this is not fulfilled, more than one A (absorbance) value will appear from several wavelengths of light.

ii. The substance analyzed is a solution with a relatively low concentration. At high concentrations this law may become invalid, because in some colorless salts at high concentrations it has the opposite absorbance effect of this law. In suspension this law also does not apply.

iii. Solutions from substances that emit fluorescent fluorescence do not always follow this law. Similarly, solutions that undergo chemical reactions (polymerization, hydrolysis, association, dissociation).

The legal validity of Lambert-Beer-Bougar can be known by calibration, and is carried out before measurement. A system can be said to follow this law if the graph between absorbance of concentration is in the form of a linear curve (straight line) through the point (0,0). Some ways to do the calibration, including the continuous variation method.

The calibration process using the continuous variation method in principle is as follows, the main reactants in the analysis process are grouped into two groups of solutions, first as a sample solution (containing substances to be analyzed) continuously varying in volume and second is a solvent whose volume is adjusted so that the amount of both have the same volume. From the mixtures having varying compositions each absorbance was determined with a spectrophotometer, then analyzed for validity (this method is detailed in chapter 3).

2.7. Analysis with a spectrophotometer

The spectrophotometer used is a UV 120 D. The workings of this spectrophotometer are in principle the same as the other previous models. The principle of this analysis is based on the reaction of ozone with KI solution, in this case the KI solution as an absorbent, where ozone gas can be optimally absorbed by this solution at neutral pH. The neutral state (pH = ± 7) is formed by providing a buffer solution of KH_2PO_4 and $Na_2HPO_4.12H_2O$.

$$2\,KI\,(aq) + O_3\,(g) + H_2O\,(aq) = I_2\,(aq) + O_2\,(g) + 2\,KOH\,(aq)$$

The O_3 level in the solution is determined based on the formation of I_2 in the solution to which the spectrophotometer responds (in the reaction equation, the O_3 coefficient is equivalent to the I_2 coefficient so that the O_3 mole is also equivalent to the I2 mole), in which I_2 absorbs the complementary color of the emitted color which is brownish yellow.

2.8. RESEARCH METHODOLOGY

2.8.1. Equipment used

The tools used in this study are: Pumpkin measuring; Glass funnel; Volume pipette; Balance; Watch glass; Cuvette; UV-VIS spectrophotometer; Stirrer; Erlenmeyer; Stopwatch; Air pressure controller; Thermometer; Midget Tube; Test tube.

2.8.2. Material used

The ingredients used in this study are: Air (21% Oxygen); Aluminium plate; Aluminum wire (3 mm diameter); Cylindrical tubes (made of glass or PVC insulators (Polyvinil Chlorida) with diameters equivalent to twice the distance between the electrodes (3,6)); copper cable; KH_2PO4 is solid; $Na_2HPO4.12.H_2O$; Solid KP; Distilled water; A standard solution of iodine 0.05 N.

2.8.3. Analysis Method

The method used is based on the analysis method of ASTM (American Society for Testing Methods) number D-2912. The methods referred to above in detail are as follows:

1. Making Absorbent Solution. It was successively dissolved 6.8 g KH_2PO_4 17.9 gr $Na_2HPO_4.12H_2O$ and 5 gr KI with 500 mL distilled water.
2. Making of Iodine Solution ($I_{2\,(aq)}$) 0.0025 N. Taken with a 5 mL pipette 0.05 N iodine solution put into a 100 mL measuring flask and then added distilled water to the mark limit. Furthermore, this solution is called a standard work solution.
3. Determination of Maximum Wavelength (λ maximum). Prepared two cuvettes. Squeeze the absorbent solution and put the cuvette to the mark, then this solution is made into a blank solution. A pipette of 0.0025 N iodine solution was put into the

other cuvette. Both cuvettes are prepared in a spectrophotometer (spectrophotometer is ready to use) to determine the maximum absorbance (maximum), and the wavelength is recorded at the time of the maximum absorbance. In the next steps the measurement is always used with these wavelengths.

4. Determination of the Calibration Curve. Prepare 0.0; 1,0; 2.0; 3.0; 4.0; 5.0 mL of 0.0025 N iodine solution each into a 25 mL measuring flask, then diluted to the mark with a flavoring solution and stirred evenly, then the solution is referred to as a sample solution. The sample solutions are transferred into the cuvette to determine its absorbance using a spectrophotometer at the maximum wavelength, (the blank used is an absorbent). A calibration curve is made between each concentration of I_2 from various variations of the sample solution in sequence with its absorbance to be determined from the slope, and symbolized by K. The desired calibration curve is plotted with the values of A (absorbance) as the ordinate (y-axis)) and the prices of C (concentration) are abscissa (x-axis), which can more clearly be seen a table that includes the data forming the curve, namely table 2.1.

Table 2.1. Retrieval of data to form a calibration curve

Standard Solution SS	Absorbent Solution AS	Sample Solution SS+AS	Absorbance	Calibration Concentration
mL	mL	mL	A	I_2 (ppm)
0	25	25	A1	C1
1	24	25	A2	C2
2	23	25	A3	C3
3	22	25	A4	C4
4	21	25	A5	C5
5	20	25	A6	C6

$$C = \frac{\text{SS Concentration x SS Volume x MW I2}}{\text{Sample Volume x n}} \text{ x } 1000 \qquad (12)$$

where, the initial concentration of LK is 0.0025 N and x is (1, 2, 3, 4, 5, 6) and n is the valence number.

5. Determination of Ozone Levels. Ozone levels are determined using equation (13):

$$\text{Level of } O_3 = \text{Iodine Concentration x } \frac{\text{MW Ozone}}{\text{MW Iodine}} \qquad (13)$$

where, C_t is the concentration of I_2 (in ppm) at various variations of t in step 5, and is determined by the equation $A_t = kC_t$. At is the absorbance (measured at maximum wavelength) measured at various variations at t in step 5, where K is the slope determined from the calibration curve equation. BM is the molecular weight of the compound in question.

6. Reactor Testing. Testing is done by observing changes in ozone levels over time (t) (explained in the 4th treatment) and t varies to 1; 1,5; 2; 2.5; and 3 minutes and the inlet air velocity is made constant (2.4 L / min). A table which includes variations in the price of t and ozone levels obtained in various variations of t, can be seen in table 3.2 for more details.

Table 2.2. Retrieval of data ozone levels to t

t	Absorbance	Level Ozone
Minutes	A	ppm
1	A1	C1
1,5	A2	C2
2	A3	C3
2,5	A4	C4
3	A5	C5

Curves are made from the data in table 3.2, where ozone levels are ordinate and time is absent. The curve is an interpretation of the state of the reactor tested. The test used is a linear test (linear regression theory) that works with Minitab software. The parameters are H_o (linear curve) and H_1 (non-linear curve), and the determination is based on the magnitude of the error probability (P) value of the fault tolerance (∞). If the P value is less than the value ∞ (in the laboratory equipment test ∞ is 0.05) then Ho is accepted and the reactor can be considered suitable for use as equipment.

3. RESULTS AND DISCUSSION

Research into the use of high-voltage electrodes to produce ozone gas provides results that will be discussed in this chapter. The results obtained include reactor model.

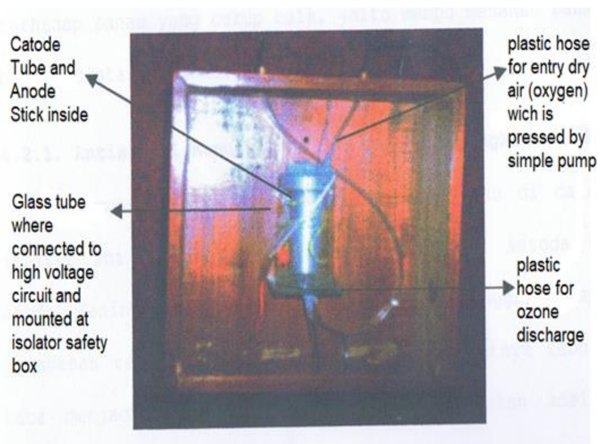

Figure 3.1. Reactor model

Other results are the data from the spectrophotometric analysis of sample solutions or samples.

3.1. Reactor Tubes

The reactor model created in this study is as shown in Figure 3.1. There are electrodes such that collisions between photons and oxygen molecules can be optimized and stoichiometric calculations can be fulfilled.

The main components in the reactor are two electrodes, namely anode and cathode. In accordance with its function as a photon generator, the electrode material chosen must meet the requirements as described in the previous chapter. The type of metal that includes meeting these requirements is aluminum, which in addition to cheap is also easily obtained in the market. Aluminum also has good resistance to the corrosive nature of oxygen. The walls of the reactor tubes are made of tightly porous glass so that the possibility of oxygen or ozone leaks in the glass pores can be ignored. This glass tube has a fairly good resistance to heat, which is able to withstand heat to boiling water temperature.

3.2. Calibration

The calibration process has been explained in previous, and the data obtained are in table 2.1. The slope of the curve formed by the plot between iodine (ppm) and absorbance levels is 0.0108 (known using the linear regression method through the point (0.0)). The equation of the regression curve is found in equation (14) and the image of the calibration curve presented in figure 3.2 below,

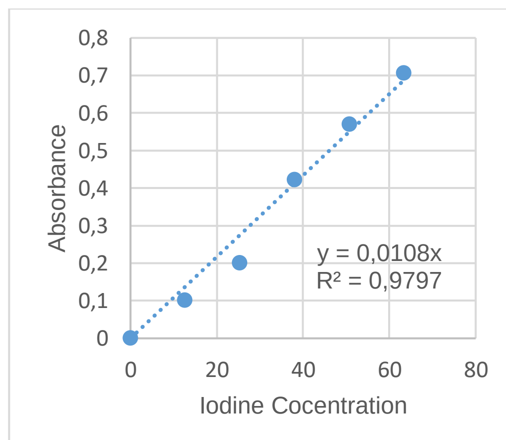

Figure 3.2. Calibration Curve

$$A = 0.0108\ C \tag{14}$$

where A (absorbance) as ordinate (y axis) and C (concentration (ppm) of I_2) as abscissa (x axis). An example of a calculation in determining the calibration concentration (C_C) I_2 at volume I_2 (volume of standard working solution) of 1 mL is as follows:

$$Cc = \frac{\text{C Iodine x SS Volume x MW Iodine}}{\text{Sample Volume x n Iodine}} \text{ x } 1000 \text{ ppm}$$

$$Cc = \frac{0{,}0025\ N \times 1\ mL \times 253{,}840\ gr/mol}{25\ mL} \times 1000\ ppm$$

Cc = 12,692 ppm

and for calculations on various volumes of standard solutions as a whole can be seen in the data in table 3.1.

Table 3.1. Various levels of I_2 (ppm) in the calibration process (calibration of standard working solution I_2).

Standard Solution (SS) mL	Absorbent Solution (AS) mL	SS + AS (Sample Solution) mL	Spectro-Absorbance A	Calibration $I_{2\ i}$ in (ppm)
0	25	25	0	0
1	24	25	0,1	12,692
2	23	25	0,2	25,384
3	22	25	0,421	38,076
4	21	25	0,57	50,768
5	20	25	0,706	63,46

3.2.1. Linear Test

The test is carried out according to the analysis method described in chapter 2.8.3. The time and absorbance data used and the ozone levels obtained by equation (13) are in table 3.2.

Table 3.2. Test data for the feasibility of a high voltage electrode reactor

Time Minutes	Mean of Absorbance A	Level Ozone ppm	maximum wavelength nm
1	0,103	2,136	352
1,5	0,267	5,538	
2	0,425	8,814	
2,5	0,585	12,133	
3	0,727	15,079	

Total of Ozone Level = 43,7 ppm

Mean of absorbance is the average value of absorbance at each predetermined time interval, which can be more clearly seen in figure 3.3 below

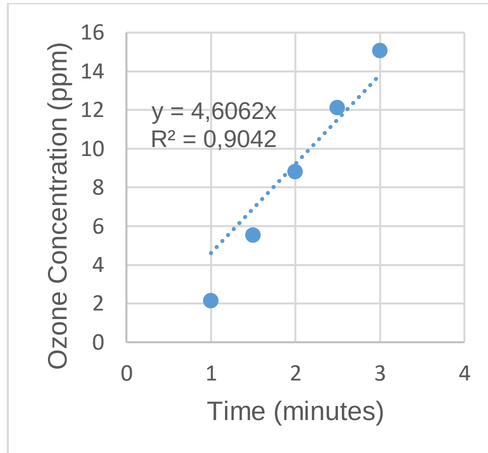

Figure 3.3. Interpretation Curve of ozone reactor

The calculation of determining ozone levels in table 3.2 for example is as follows (in this case at t = 1 minute and then A = 0.103 is obtained):

C1 minute = A1 minute / Calibration

= 0.103 / 0.0108

= 9.537 ppm

According to the reaction between KI and ozone contained in chapter 3, the coefficient of O_3 is equivalent to the coefficient of I_2, then the mole of O_3 is equivalent to the mole of I_2. So, the concentration of ozone is as follows:

ozone levels (ppm) = Ct x (MW O_3 / MW I_2)

= C1 minute x (48 gr.mol^{-1} / 253.84 gr.mol^{-1})

= 9.537 ppm x 0.224

= 2,136 ppm

Calculation of ozone levels for the other t can be seen in Appendix 4. As a basis for analysis (interpretation) of the reactor state, a regression curve is made, where time (t) is absent and ozone levels (ppm) as the ordinate. The test parameters include a pair of conflicting statements (expressed as Ho (linear curve) and H_1 (non-linear curve)), and the comparison parameter is the error tolerance value which is denoted as ∞ . The parameter ∞ have a certain price that is proportional to the desired level of accuracy (in exact terms the price ∞ used is generally 5%, except in medicine, which is equal to 1%). Analysis is done by using Minitab software to determine the probability level of error (P). And P value is compared with value ∞, if P value is smaller than Ho can be accepted and H_1 is rejected, and if P is greater than ∞, H_1 is accepted and Ho is rejected. The level of relationship (correlation coefficient) between the data obtained can also be known through Minitab, and this can be shown in a regression curve, this correlation level is denoted by R-square (R-sq) or R^2, but it can also be known level the possibility of data entered in the system can be received and this is denoted R-square-adjective (R-sq-adj) or Radj. R^2 and Radj are determined at the beginning of the analysis process before proceeding to the next stage.

Based on data obtained from experiments (table 3.1) and data on ozone levels (ppm) and time data (minutes) a regression curve (linear regression) can be seen in figure 3.3, and R^2 of 90.42% is obtained. The price of R^2 is large enough so that further analysis of the data that will be carried out with Minitab is worth continuing. The Minitab process can be more clearly seen in stage details below

Regression Analysis

Regression Equation = **ppm = 0.27 + 3.21 minute**

Prediction	Coeff	Stdev	t-Ratio	p
Constant	0.266	1.721	0.15	0.887
Minute	32.116	0.8113	3.96	0.029

s = 1.283 R-aq = 83.9% R-aq(adj) = 78.6%

Analysis of Variance

Source	DF	SS	MS	F	p
Regressior	1	25.786	25.786	15.67	0.029
Error	3	4.936	1.645		
Total	4	30.722			

Figure 3.4. Minitab software printed

The curve above (figure 3.3) is processed by this minitab software, and from the curves obtained the following regression equation:

$$O_3\,(\text{ppm})\text{-level} = 4.61\ t \qquad (15)$$

and the price of P is 0,000.

The test parameters determined in this analysis are as follows,

Ho = linear curve

H_1 = non-linear curve

and the comparison parameter (∞) is 0.05. The P value of 0,000 compared to the ∞ value (0.05), turns out to be smaller (0,000 <0.05), so that the Ho that contains the statement that the curve is linear is acceptable.

The purpose of the linear test is to determine the feasibility of reactor based on the formation of a regression curve from the acquisition of data about the ozone levels formed in a certain time that varies according to continuous increase. It turns out that in this chapter it can be proven that the curves formed are linear, so the reactor equipment tested can be considered feasible (The shape of the reactor's state of interpretation curve can be seen in figure 3.3).

3.4. Reactor Performance

The performance of the reactor (PR) in question is the ability of the reactor to produce ozone gas each time unit. The performance of this reactor is known by calculating the average ozone concentration per unit time. Ozone performance is obtained by dividing the total amount of ozone content (ppm) by the total amount of time (minutes). Total ozone levels can be seen in table 3.2. For more details, the calculation is as follows:

$$P.R. = \frac{\text{Total amount of O3 levels}}{\text{Total amount of times}} \quad (16)$$

$$= \frac{2{,}136+5{,}538+8{,}814+12{,}133+15{,}079}{(1+1{,}5+2+2{,}5+3)}$$

$$= \frac{43{,}7 \text{ ppm}}{10 \text{ menit}}$$

= 4,37 ppm/minutes

So it can be concluded temporarily that the reactor that has been made by utilizing high voltage as an initiator can produce ozone from dry air an average of 4.37 ppm every minute (it is assumed that dry air contains 21% oxygen and is flowed into the reactor at speed 2, 4 L / min).

3.5. Reactor Efficiency

The efficiency of this high voltage electrode reactor equipment and incandescent electrode reactor (which was explained in previous chapter) can also be known by assuming that the oxygen converted to ozone comes from dry air, and is contained by 21% (this assumption is based on some quite popular literature). Various gases contained by dry air (the other 79%) other than oxygen did not affect the feasibility of this experiment because the test method used was based on a method that was only sensitive to the effects of ozone to the absorbent solution used in this experiment (ASTM D-2912).

The efficiency of both reactors is formulated as follows:

$$\frac{\text{O3 Concentration Out}}{\text{O2 Concentration In}} \text{x}100\% = \% \text{ efficiency} \quad (17)$$

Incoming oxygen levels as much as 21% of 2.4 L / min, then the oxygen absorbed per minute is 0.504 L. That amount is equal to 360 mg / L or 360 ppm.

Then the efficiency of the previously made incandescent electrode reactor is as follows:

$$\frac{2{,}57\,ppm}{360\,ppm} \text{ x } 100\,\% = 0{,}714\,\%$$

whereas, the efficiency of the high voltage electrode reactor made in this study is as follows:

$$\frac{4{,}37\,ppm}{360\,ppm} \text{ x } 100\,\% = 1{,}214\,\%$$

So the efficiency of high voltage electrode reactor is better when compared to incandescent electrode reactor.

3.6. The Effect of Continuous Photon Discharge on Reactor Performance, Efficiency and Eligibility

The intended photon discharge is an electron discharge from the cathode to the anode that occurs in the reactor tube. In Chapter 2, it has been explained that to achieve optimal results (performance and efficiency), the number of moles of photon that is stripped is 1/3 of the mole of oxygen that passes.

The reactor tube model used (Figure 3.1) has placed electrode pairs in such a way that every mole of oxygen passed will be crushed by a photon discharge with an appropriate number of moles, but the performance and efficiency shown remain low (4.37 ppm / min performance and efficiency 1,214%).

The low performance and efficiency are estimated due to the symptom discontinuity of photon discharges when the reactor is operated. Symptoms that can be observed by ordinary eyes are the emergence of purple and red rays that are not continuous (can be observed from the reactor tube made of transparent glass). Symptoms of discontinuity are clearly visible, so that in one minute several times occur outages (in one minute does not always occur full photon stripping). So, in one minute there are a few moles of passing oxygen which are not crushed by photon discharges, thereby reducing the performance and efficiency of the reactor.

The feasibility of the reactor does not depend directly on performance or efficiency, because this is determined statistically (in this case with linear regression combined with minitab software, and has been described in chapter 3.2.1) after a thorough analysis of all data obtained, it turns out that these photon stripping discontinuity symptoms have no direct effect on the suitability of the reactor. This can be proven in chapter 3.2.1 where Ho (linear curve) can be accepted.

4. CONCLUSION

Based on data obtained from experiments and after discussion, several conclusions can be drawn, as follows:

First, the ozone producing reactor (reactor) based on the high voltage electrodes tested was found to be feasible based on Linear and Minitab Regression testing. Where the Comparative Parameter (∞) is 0.05 and the Probability Rate of Error (P) is 0,000, because P < ∞ then the Acceptable Test Parameter is Ho (Linear Curve). So that the acquisition of data from experiments is considered feasible as well as the test ozone reactor (Reactor) equipment can be said to be feasible.

Second, the performance of the ozone-producing reactor tested showed an increase of 1.8 ppm in every minute compared to the performance of a previously made incandescent reactor (used as a comparison in this study), where a high voltage electrode-based reactor had a performance of 4.37 ppm per minute and the incandescent electrode reactor has a performance of 2.57 ppm per minute.

Third, the efficiency of high voltage electrode reactor is better than incandescent electrode reactor, and an efficiency increase of 0.5%, where the efficiency of high voltage electrode reactor is 1.214% while incandescent electrode reactor is 0.714%.

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ZINC ANODE ANALYSIS USED KRI WITH COMPOSITION AND POTENTIAL CORROSION PARAMETERS TEST

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ABSTRACT

Several types of zinc anodes have been produced with a variety of different compositions. The variations in the composition of the zinc anode provide different corrosion protection performance. In this study, tested the characteristics of several zinc anode products and their performance in steel corrosion protection. The tests carried out included the composition test using the dry method and the wet method on KRI Zinc, Pure Zinc, and Commercial Zinc. The standard used is the US Military Specification (MIL - A - 18001 - H) standard. In addition to composition testing, the potential difference of each zinc anode is also taken, to determine the potential value of each zinc anode for protection potential, and also for cathodic protection. From the results of the dry composition test, a value that is easy to evaluate is obtained. For testing with the wet method, the value that comes out still needs to be converted to weight percent units. Of the three Zinc, which does not meet the US Mlitary Specification (MIL - A - 18001 - H) standard, namely commercial zinc, because there is an impurity in the form of Fe whose value is greater than the allowable amount of 0.005% according to the US Mlitary Specification (MIL - A - 18001 - H), which can interfere with the performance of the Zinc Anode itself. For the results of the potential difference test, the three Zinc can be used as a sacrificial anode in cathodic protection because there are impurities in the form of Fe whose value is greater than the allowable amount of 0.005% according to the US Military Specification (MIL - A - 18001 - H) standard, which can interfere with the performance of the Zinc Anode itself. For the results of the potential difference test, the three Zinc can be used as a sacrificial anode in cathodic protection because there are impurities in the form of Fe whose value is greater than the allowable amount of 0.005% according to the US Military Specification (MIL - A - 18001 - H) standard, which can interfere with the performance of the Zinc Anode itself. For the results of the potential difference test, the three Zinc can be used as a sacrificial anode in cathodic protection.

Keywords: zinc anode, offering anode, protection potential.

1. INTRODUCTION

The Indonesian Navy as the guard of the Indonesian sea, very much depends on the readiness of a defense equipment, including the KRI, which is an underwater building that is exposed to very corrosive sea water conditions, where sea water corrosion is the biggest source of damage to the ship. Corrosion to the hull of the ship can result in a decrease in ship resistance, ship life time and reduce the safety and security of the ship crew. To avoid losses due to seawater corrosion, the ship hull plate needs regular corrosion protection to slow down the corrosion rate. To protect the hull plate against seawater corrosion, 2 (two) methods are used, namely passive protection (by painting) and active protection (by using the cathodic protection method). Cathodic protection can be carried out in two ways. namely by using the sacrificial anode and the pressure current (ICCP). Cathodic protection with sacrificial anodes occurs when a metal is connected to a more reactive metal (anode). This relationship leads to a galvanic circuit. In order to effectively remove corrosion from metal structures, the anode material must have a potential difference large enough to generate an electric current. The effective use of cathodic protection will provide good protection over the entire surface area of the material. The combination of coating and cathodic protection will provide a more economical and effective option to protect materials in soil and sea water environments. This final project focuses on testing the composition of the sacrificial anode made of zinc (Zn) metal according to US standard.

2. THEORETICAL BASIC

2.1 Zinc and Characteristics

It is the 24th abundant element in the Earth's crust and has stable isotopes. The most abundant zinc ore in the mine is salerite (zinc sulfide), brass which is a mixture of copper and zinc alloys. It has been in use since at least the 10th century BC. The metal impure zinc began to be produced on a large scale in the 13th century in India, when the metal was still unknown to Europeans until the end of the 16th century. Alchemists burned zinc to produce what they called "white snow or philosopher's wool. ". The German chemist Andreas Sigismued Marrgraf is generally credited with discovering pure zinc metal in 1746. Luigi Galvani and Alessandro Volta's work successfully revealed the electrochemical properties of zinc in 1800 AD.

2.2 Zinc Alloy

a Mixture of Zn with Cu

CuZn alloys with a Cu content of at least 55% are known as Brass. Brass is usually used for pipes that are corrosion resistant. The color of brass is influenced by the amount of Zn.

b. Mixture of Zn with Mg

The combination of Zn and Mg is commonly used in household appliances.

Mixture of Zn with Cu and Ni

c. This alloy is commonly referred to as silver. Its composition is Cu 60%, Zn 20%, Ni 20%. Examples of use in spoons, silver metal, and so on.

d. Mixture of Zn with Al

Zn and Al alloys are commonly used for steel protection, so that the steel is not exposed to corrosion, which is commonly referred to as Zn Anode.

2.3 Elements in Zinc

The alloying elements in Zinc Alloy are: Tin (Sn), Cadmium (Cd), Iron (Fe), Copper (Cu), Aluminum (Al), Lead (Pb), Magnesium (Mg)

2.4 Corrosion and protection

Corrosion is the degradation of metals due to interaction with their environment, because naturally the metal will return to a more stable thermodynamic condition as its compounds.

2.5 The Pourbaix diagram

If iron (Fe) immersed in an electrolyte solution undergoes four types of corrosion that may occur:

1. Formation of iron hydroxide (only H^+ plays a role).
2. Anodic reaction (only e^- plays a role).
3. Formation of iron hydroxide (H^+ and e^- which play a role).
4. Formation of carbonic acid (both H^+ and e^- have no role).

Reaction a, depending on pH. Reaction b, depending on the potential. The c reaction depends on both the pH and potential components, while the d reaction is independent of pH or potential. The four reactions above, if substituted with the Nernst equation, get a potential and pH relationship, which when a potential = f (pH) diagram is made is called the Pourbaix diagram.

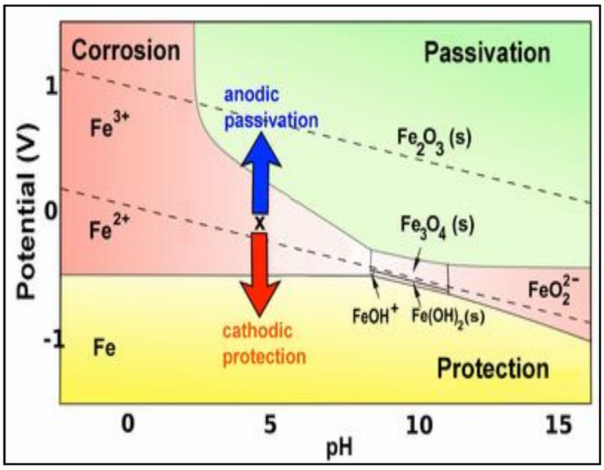

Figure 2.1 Pourbaix diagram

3. DATA ANALYSIS

3.1 Dry Composition Test Results

Testing the chemical composition of the KRI, Pure and Commercial Zinc anode in the dry way using the Foundry Master Pro tool.

Table 4.1 The chemical composition of the dry method of the three types of Zinc Anode

Element	Zn Anode (% weight)			US(Mil-A-18001-H)
	Indonesian warship	Pure	Commercial	
Zn	99.8	99.9	99.6	Remainder
Al	0.1210	0.0045	0.102	0.10-0.50
Cd	0.0141	0.0001	0.0023	0.025-0.15
Cu	<0.0020	0.0026	0.0777	Max 0.005
Fe	<0.0020	<0.0020	0.0272	Max 0.005
Pb	0.0087	0.0111	0.0422	Max 0.006
Si	0.0007	0.0005	0.0008	Max 0.015
Mg	0.0033	0.0069	0.0175	
Sn	0.0077	0.0112	0.021	

From Table 4.1 the testing of the three samples, according to the US Military Specification (Mil - A - 18001 - H) standard, for KRI samples the elements can be obtained from the composition test, namely Zn of 99.8%, entering the remainder as the main element forming Zinc Anode metal, included in the US Military Specification standard (Mil - A - 18001 - H). Al element is 0.121%, included in the US Military Specification (Mil - A - 18001 - H) standard, which is between 0.10 - 0.50%. The Cd element of 0.0141% is not included in the US Military Specification (Mil - A - 18001 - H) standard, which is under the 0.025 - 0.15% range. The function of Cd in the zinc anode is to reduce the intergranular corrosion resistance of the steel, if the element of Cd exceeds the upper range, it will cause the intergranular corrosion resistance of the steel to decrease, if the Cd is below that range, then the intergranular corrosion resistance will decrease, which causes the zinc anode to run out quickly. Cu element is <0.0004%, this value is below the max 0.005%, which is included in the US Military Specification standard (Mil - A - 18001 - H). Fe element of <0.0020%, whose value is below the max. 0.005%, is included in the US Military Specification standard (Mil - A - 18001 - H). The Pb element has a value of 0.0087%, this value exceeds the max. 0.006%, with an excess of 0.0027% that does not enter the US Military Specification standard (Mil - A - 18001 - H). The function of Pb on the zinc anode if the value exceeds it will cause the formation of intergranular corrosion. The element of Si is 0.0007%, this value is below the Max.0.015%, entering the US Military Specification standard (Mil - A - 18001 - H). From these data, it can be concluded that Zinc KRI is still included in the standard U.

In pure zinc, the elements are obtained from the composition test, namely Zn of 99.9%, the remainder is the main element that forms Zinc Anode metal, which is included in the US Military Specification standard (Mil - A - 18001 - H). Elemental Al of 0.0045%, is included in the US Military Specification (MIL - A - 18001 - H) standard, which is under the range 0.10 - 0.50%. The aluminum element itself in Zinc Anode affects the strength, ductility and hardness of Zinc anode. The Cd element of 0.0001% does not enter the US

Military Specification (MIL - A - 18001 - H) standard, which is below the 0.025 - 0.15% range. The function of Cd in zinc anode is to reduce intergranular corrosion resistance in steel. If the element Cd exceeds the upper Range, it will cause the intergranular corrosion resistance of the steel to decrease, if the Cd is below that Range, then the intergranular corrosion resistance will decrease, which causes the zinc anode to run out quickly. Cu element is 0.0026%, this value is below the max 0.005%. included in the US Military Specification Standard (MIL - A - 18001 - H). Fe element of <0.0020%, whose value is below the max. 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). The value of Pb element is 0.0111%, this value exceeds the max. 0.006%, with an excess of 0.0051% that does not enter the US Military Specification Standard (MIL - A - 18001 - H). The function of Pb on the zinc anode if the value exceeds it will cause the formation of intergranular corrosion. Element Si is 0.0005%, this value is below Max.0.015%, entered into the US Military Specification Standard (MIL - A - 18001 - H). From these data, it can be concluded that Pure Zinc is still included in the U standard.

In commercial zinc, the elements are obtained from the composition test, namely Zn of 99.6%, the remainder is the main element that forms Zinc Anode metal, which is included in the US Military Specification standard (Mil - A - 18001 - H). Elemental Al of 0.102%, included in the US Military Specification Standard (MIL - A - 18001 - H), which is between 0.10 - 0.50%. The aluminum element itself in Zinc Anode affects the strength, ductility and hardness of Zinc anode. The Cd element of 0.0023% is not included in the US Military Specification Standard (MIL - A - 18001 - H), which is under the Range 0.025 - 0.15%. The function of Cd in zinc anode is to reduce intergranular corrosion resistance in steel. If the element Cd exceeds the upper Range, it will cause the intergranular corrosion resistance of the steel to decrease, if the Cd is below that Range, then the intergranular corrosion resistance will decrease, which causes the zinc anode to run out quickly. Cu element is 0.077%, the value is above the max 0.005%. not included in the US Military Specification Standard (MIL - A - 18001 - H). The Cu element in the zinc anode will show a white (ε phase) color. Fe element is 0.0272%, whose value is above the max. 0.005%, with an excess of 0.0222%. If the Fe value exceeds the maximum standard of the US Military Specification Standard (MIL - A - 18001 - H), it will damage the performance of the Zinc anode. The Pb element has a value of 0.0422%, this value exceeds the max. 0.006%, with an excess of 0.0362% that does not enter the US Military Specification Standard (MIL - A - 18001 - H). The function of Pb on the zinc anode if the value exceeds it will cause the formation of intergranular corrosion. Element Si is 0.0008%, This value is below the Max.0.015%, entering the US Military Specification Standard (MIL - A - 18001 - H). From these data, it is concluded that commercial zinc is not included in the standard US Mil Specification (Mil - A - 18001 - H), because its impurities such as Fe and Pb are too large, the excess values are 0.0222% and 0.0362% which will be causing disruption of the zinc anode performance.

Of the three Zinc Anode products tested with the dry method, the ones that enter the US Military Specification Standard (Mil - A - 18001 - H) are KRI Zinc and Pure Zinc, while Commercial Zinc is not included in the US Military Specification standard (Mil - A - 18001) - H).

3.2 Wet Composition Test Results

Testing the chemical composition of the wet model on KRI, Pure and Commercial Zinc anode using ICP (Inductively Coupled Plasma) which is owned by the Navy Chemical and Materials Main Laboratory (LABIKIMAT).

Conversion of units from (mg / L) to percent (%) by weight For example: for the test results above with the results of Fe in test I, namely 2.22188 mg / L, i.e. with a sample of 1 gram in 100 mL of water

1000 mg / 0.1 L = 10000mg / L

$$\frac{2{,}22188\ mg/L}{10.000 mg/L} \times 100\% = 0{,}0222188\%$$

Unsur	Zinc Murni	Zinc Komersial	Standart US (MIL-A-18001-H)
Ag	0,024116	0,002378	
Al	0,960495	8,96002	0,10 - 0,50
As	-0,132980uv	-0,114728uv	
B	-0,011936uv	-0,014585uv	
Ba	0,014573	0,014439	
Bi	0,000614uv	0,006979uv	
Ca	0,09715	0,09173	
Cd	0,020545	0,06535	0,025 - 0,07
Co	0,004384	0,003893	
Cr	-0,000776uv	0,02395	
Cu	-0,001860uv	0,592896	Max 0,005
Fe	0,161454	1,56379	Max 0,005
Ga	-0,019074uv	-0,018161uv	
In	uncal	uncal	
K	0,54522uv	0,558129	
Li	0,011595	0,01359	
Mg	0,038199	0,019548	
Mn	0,000203	0,007877	
Mo	-0,007502uv	-0,000042uv	
Na	1,1228	0,459948	
Ni	-0,063958	0,053083	
Pb	-0,007029uv	0,428611	Max 0,006
Se	uncal	uncal	
Sr	0,000703	0,000569	
Ti	0,053187	0,017195uv	
Zn	147,234	145,669	Remaider

From the test results of the three samples, according to the US Military Specification (Mil - A - 18001 - H) standard, for KRI samples the elements were obtained from the composition test, namely Zn of 1.4502%, entering the remainder as the main element that forms Zinc Anode metal, included in the US Military Specification standard (Mil - A - 18001 - H). Elemental Al of 0.163%, included in the US Military Specification Standard (MIL - A - 18001 - H), which is between 0.10 - 0.50%. The Cd element of 0.00311% is not included in the US Military Specification Standard (MIL - A - 18001 - H), which is below the 0.025 - 0.15% Range. The function of Cd in zinc anode is to reduce intergranular corrosion resistance in steel. If the element Cd exceeds the upper Range, it will cause the intergranular corrosion resistance of the steel to decrease, if the Cd is below that Range, then the intergranular corrosion resistance will decrease, which causes the zinc anode to run out quickly. Cu element is -0.0000276uv%, this value is below the max 0.005%, included in the US Military Specification Standard (MIL - A - 18001 - H). The element of Fe of 0.0005%, with a value of max. 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). The Pb element has a value of -0.000056uv%, this value is below the max. 0.006%, entered into the US Military Specification Standard (MIL - A - 18001 - H). From these data, it can be concluded that Zinc KRI is included in the US Military Specification (Mil - A - 18001 - H) standard. 0005%, with a max value of 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). The Pb element has a value of -0.000056uv%, this value is below the max. 0.006%, entered into the US Military Specification Standard (MIL - A - 18001 - H). From these data, it can be concluded that Zinc KRI is included in the

US Military Specification (Mil - A - 18001 - H) standard. 0005%, with a max value of 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). The Pb element has a value of -0.000056uv%, this value is below the max. 0.006%, entered into the US Military Specification Standard (MIL - A - 18001 - H). From these data, it can be concluded that Zinc KRI is included in the US Military Specification (Mil - A - 18001 - H) standard.

In pure zinc, the elements are obtained from the composition test, namely Zn of 1.4723%, the remainder is the main element that forms Zinc Anode metal, which is included in the US Military Specification standard (Mil - A - 18001 - H). Al element is 0.0096%, not included in the US Military Specification Standard (MIL - A - 18001 - H), which is below the range 0.10 - 0.50%. The aluminum element itself in Zinc Anode affects the strength, ductility and hardness of Zinc anode. The Cd element of 0.0002% is not included in the US Military Specification Standard (MIL - A - 18001 - H), which is under the Range 0.025 - 0.15%. The function of Cd in zinc anode is to reduce intergranular corrosion resistance in steel. If the element Cd exceeds the upper Range, it will cause the intergranular corrosion resistance of the steel to decrease, if the Cd is below that Range, then the intergranular corrosion resistance will decrease, which causes the zinc anode to run out quickly. Cu element is -0.0000186uv%, this value is below the max 0.005%, included in the US Military Specification Standard (MIL - A - 18001 - H). Fe element of 0.0016%, whose value is below the max. 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). The Pb element has a value of -0.000070uv%, included in the US Military Specification Standard (MIL - A - 18001 - H), the value is below the max. 0.006%. From these data it can be concluded that Pure Zinc is included in the US Military Specification standard (Mil - A - 18001 - H), S Military Specification (MIL - A - 18001 - H). Fe element of 0.0016%, whose value is below the max. 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). The Pb element has a value of -0.000070uv%, included in the US Military Specification Standard (MIL - A - 18001 - H), the value is below the max. 0.006%. From these data it can be concluded that Pure Zinc is included in the US Military Specification standard (Mil - A - 18001 - H), S Military Specification (MIL - A - 18001 - H). Fe element of 0.0016%, whose value is below the max. 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). The Pb element is -0.000070uv%, included in the US Military Specification Standard (MIL - A - 18001 - H), the value is below the max. 0.006%. From these data it can be concluded that Pure Zinc is included in the US Military Specification standard (Mil - A - 18001 - H),

In commercial zinc, the elements are obtained from the composition test, namely Zn of 1.456%, entering the remainder, namely as the main element that forms Zinc Anode metal, which is included in the US Military Specification standard (Mil - A - 18001 - H). Al element is 0.0896%, not included in the US Military Specification Standard (MIL - A - 18001 - H), which is below 0.10 - 0.50%. The aluminum element itself in Zinc Anode affects the strength, ductility and hardness of Zinc anode. The Cd element of 0.00065% is not included in the US Military Specification Standard (MIL - A - 18001 - H), which is under the Range 0.025 - 0.15%. The function of Cd in zinc anode is to reduce intergranular corrosion resistance in steel. If the element Cd exceeds the upper Range, it will cause the intergranular corrosion resistance of the steel to decrease, if the Cd is below that Range, then the intergranular corrosion resistance will decrease, which causes the zinc anode to run out quickly. Cu element is 0.005%, this value fits within the max limit of 0.005%, is included in the US Military Specification Standard (MIL - A - 18001 - H). Fe element is 0.0156%, whose value is above the maximum, namely 0.005%, with an excess of 0.0106%. If the Fe value exceeds the maximum standard of the US Military Specification Standard (MIL - A - 18001 - H), it will damage the performance of the Zinc anode. The Pb element has a value of 0.00428%, this value is below the max. 0.006%, entered into the US Military Specification Standard (MIL - A - 18001 - H). From these data, it is concluded that commercial zinc is not included in the US Military Specification (Mil - A - 18001 - H) standard, because its impurities such as Fe, which have too large an excess value of 0,

Of the three Zinc Anode products tested using the wet method, the ones that enter the US Military Specification Standard (Mil - A - 18001 - H) are KRI Zinc and Pure Zinc, while Commercial Zinc is not included in the US Military Specification standard (Mil - A - 18001) - H).

From the composition test using either the wet method or the dry method there is not much difference in the composition results according to the US Military Specification standard (Mil - A - 18001 - H). Of the three samples tested, only commercial Zinc did not meet the US Military Specification (Mil - A - 18001 - H) standard, while KRI and Murni Zinc approached the US Military Specification standard (Mil - A - 18001 - H) with tolerance considerations due to not all zinc anode products meet the desired specifications.

The differences between the dry and wet method composition test, namely the dry method test results obtained values that can be directly compared to the specifications we want, while in the wet method testing, the results obtained are values that still have to be converted into mass quantities.

3.3 Testing Anova Test

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Zn	Between Groups	.136	2	.068	61.000	.000
	Within Groups	.007	6	.001		
	Total	.142	8			
Al	Between Groups	.024	2	.012	10579.900	.000
	Within Groups	.000	6	.000		
	Total	.024	8			
Cd	Between Groups	.000	2	.000	1627.000	.000
	Within Groups	.000	6	.000		
	Total	.000	8			
Cu	Between Groups	.012	2	.006	332.342	.000
	Within Groups	.000	6	.000		
	Total	.012	8			
Fe	Between Groups	.001	2	.001	3523.048	.000
	Within Groups	.000	6	.000		
	Total	.001	8			
Mg	Between Groups	.000	2	.000	49.069	.000
	Within Groups	.000	6	.000		
	Total	.000	8			
Mn	Between Groups	.000	2	.000	4.000	.079
	Within Groups	.000	6	.000		
	Total	.000	8			
Ni	Between Groups	.000	2	.000	.	.
	Within Groups	.000	6	.000		
	Total	.000	8			
Pb	Between Groups	.002	2	.001	55.834	.000
	Within Groups	.000	6	.000		
	Total	.002	8			
Sb	Between Groups	.000	2	.000	1.197	.365
	Within Groups	.001	6	.000		
	Total	.001	8			
Sn	Between Groups	.000	2	.000	5.019	.052
	Within Groups	.000	6	.000		
	Total	.000	8			
As	Between Groups	.000	2	.000	.000	1.000
	Within Groups	.000	6	.000		
	Total	.000	8			
Bi	Between Groups	.000	2	.000	25.147	.001
	Within Groups	.000	6	.000		
	Total	.000	8			
Ag	Between Groups	.000	2	.000	10.500	.011
	Within Groups	.000	6	.000		
	Total	.000	8			
In	Between Groups	.000	2	.000	.565	.596
	Within Groups	.000	6	.000		
	Total	.000	8			

Based on the table above, it is known that ANOVA produces a significance of <0.05. Thus H0 is rejected and Ha is accepted, and it is concluded that there are differences in the Dry and Wet Composition of Zn, Al, Cd, Cu, Fe, Mg,Pb, Bi, and Ag,

3.4 Testing the corrosion potential with artificial sea water with the Ag / AgCl comparison electrode.

The results of the SACP (Sacrificial Anode Cahodic Protection) experiment:

N0	metal	potential(v)
1	Zn indonesian warship	-1.005
2	Zn pure	-0.977
3	Zn Commercial	-0.994
4	Fe steel	-0.463
5	Zn indonesian warship-Fe	-0.830
6	Zn pure-Fe	-0.870
7	Zn Commercial-Fe	-0.829

From the three results of testing the potential protection of zinc anode against steel, it was found that the three anodes were able to carry the steel to the protected area according to the criteria in the standard NORSOK M - 503 and on the pourbaix diagram for steel.

CONCLUSIONS

From the results of the analysis that has been done, the following conclusions are obtained:

1 From the composition test using either the wet method or the dry method there is not much difference in the composition results according to the US Military Specification standard (Mil - A - 18001 - H). Of the three samples tested, only commercial Zinc did not meet the US Military Specification standards (Mil - A - 18001 - H), while KRI and Murni Zinc approached the US Military Specification standard (Mil - A - 18001 - H) with tolerance considerations because not all zinc anode products meet the desired specifications.

2. The results of the SACP experiment obtained from the potential of each metal, namely E^0 Zinc KRI of -1.005Volts, E Murni of Pure Zinc of -0.977Volts, E of Commercial Zinc of -0.994Volts, E^0 of -0.463Volts of E^0 Fe. In addition, the cell potential between Zn KRI and Fe metals was -0.830 volts, cell potential between pure Zn metals and Fe was -0.870 volts, cell potential between commercial Zn metals and Fe was -0.829 volts. This proves that all three zinc anodes can be used as sacrificial anodes in cathodic protection, because these anodes are capable of carrying steel to protected areas according to the criteria in the standard NORSOK M - 503 as well as on the pourbaix diagram for steel.

3. The greater the difference in the potential value of the cell, the better the cathodic protection will be, but the faster the sacrificial anode will run out, in this case the Zinc anode.

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THE IMPACT OF COVID-19 ON GLOBAL SHIPPING AND MARITIME INDUSTRY IN INDONESIAN AND HOW TO COPE WITH THE CORONA VIRUS OUTBREAK BASED ON RECOMMENDATIONS WHO AND IMO

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ABSTRACT

The global share of Chinese container shipments grew from 10% in 2003 to 14% in 2019. Meanwhile, the share of dry bulk commodity imports to world volume has jumped sharply from only 11% to 34% in the same period. Based on the total dry bulk commodity, China's share in the global market is very dominant and is the main player in this industry. The rapid spread of the coronavirus has had a major impact on the global shipping market, with falling demand for goods from China impacting everything from container ships to oil tankers. Freight rates for global container lines generally fall sharply by between 10% -15%. The radical drop in demand for Chinese crude oil tankers from an average of 3.4 billion tonnes of miles per day in 2019 to almost zero. This is just the beginning of what will become a global crisis for all sectors including shipping. Therefore, this study aims to analyze the impact of the Coronavirus COVID-19 on the maritime industry, especially in Indonesia, as well as how to deal with the Coronavirus outbreak based on the recommendations of the World Health Organization (WHO) and the International Maritime Organization (IMO). The research method used in this research is a literature study with a descriptive analysis approach using the Content Analysis method as well as how to deal with the Coronavirus outbreak based on the recommendations of the World Health Organization (WHO) and the International Maritime Organization (IMO). The research method used in this research is a literature study with a descriptive analysis approach using the Content Analysis method as well as how to deal with the Coronavirus outbreak based on the recommendations of the World Health Organization (WHO) and the International Maritime Organization (IMO). The research method used in this research is a literature study with a descriptive analysis approach using the Content Analysis Method.

Keywords*: COVID-19, Maritime Industry, Global Shipping Market, Global Crisis, WHO and IMO*

1. INTRODUCTION

Has resulted in a decrease in the movement of "International Baltic and Maritime Council containers from ports in China. BIMCO explained (BIMCO) warned of a more serious impact from the that nearly 2/3 of the truck drivers in several parts of an outbreak of the Coronavirus in China on the shipping China has not yet arrived at work. BIMCO analyst and trade industry if the disaster continues and is Peter Sand describes three possibilities that will not resolved soon. BIMCO explained, occur with different impacts on the activity of from January to February 26, the volume had lost to delivery. First, if China manages to exercise control a point of 1.7 million TEUs "(BIMCO, 2020). This shortly, Chinese factory activity will return figure is based on the number of shipping to normal in March. The second possibility, cancellations starting in the Chinese New Year normalization does not occur until April; and third (Imlek) and the low level of loading (load factor) of a (predictable) viruses continue to spread in ways that number of costs during the outbreak of the virus due are impossible to predict or analyze. If it is the first to a lack of volume of goods. This decrease is also possibility, then the impact on global supply chain the result of a decrease in landside trucking, which activities are relatively small. If the second possibility occurs, let alone the third possibility , the impact will be more serious for manufacturing, transportation, and sports activities. Currently, the cessation of production activities has resulted in a decline in container volumes. However, if this continues, it will disrupt the supply chain to retail activities. The outbreak of the Coronavirus has proven that the level of dependence of the shipping industry on the Chinese economy is so high. If industrial activities in China stopped

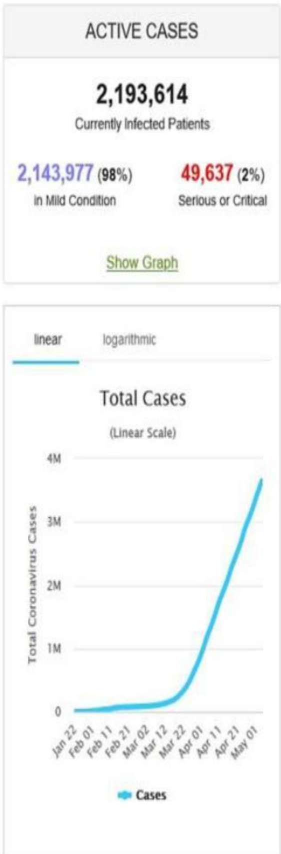
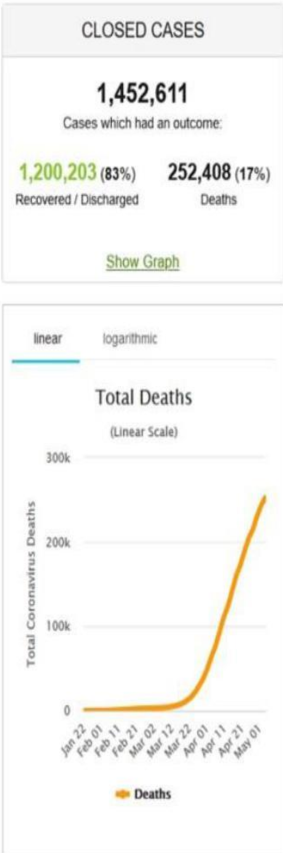
	

Figure 1A, Statistical Data *Coronavirus Infection 2019*	**Figure 1B**, Statistical Data *Coronavirus Infection 2019*

The causal relationship between the COVID-19 pandemic that occurred in Wuhan, China, and the global economy, encouraged the author to further analyze the impact on global shipping conditions and the maritime industry, especially in Indonesia. As well, analyzing the pattern of handling by the Indonesian government on monitoring and

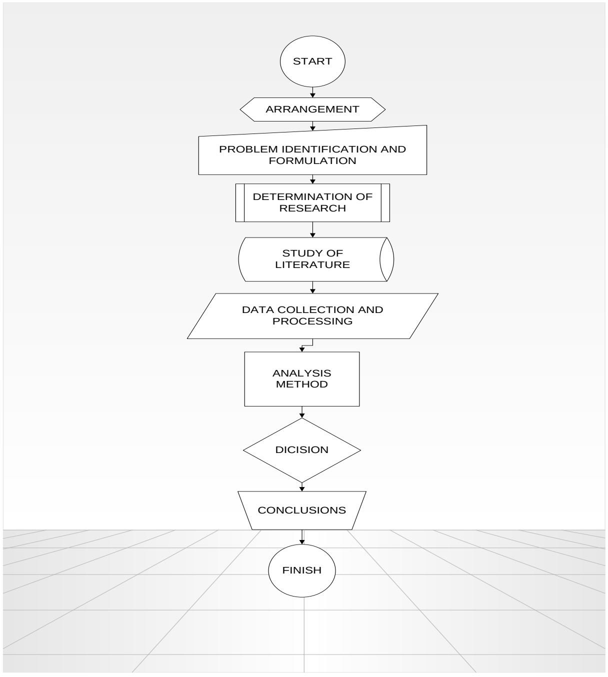
operating, the shipping industry would come to a standstill

As the first country to be hit by Covid-19, now China is the only country with a recovering economy and a resurgent population. It can be seen that the spread of the pandemic is increasing day by day. A total of 212 countries were infected with COVID-19, with a total of 3,646,225 cases as of May 5, 2020, 252,408 deaths, and 1,200,203 cases of recovery as shown in Figure 1. below:

preventing the entry of COVID-19 into Indonesian territory through the maritime sector based on recommendations from the World Health Organization (WHO) and the International Maritime Organization (IMO) and other related parties.

2. RESEARCH METHODS

The method used in this research is the Content Analysis Method with a focus on literature study, namely all efforts made by the researcher to gather information relevant to the topic or problem that will be or is being researched. Information that can be obtained from scientific books, research reports, scientific essays, theses and dissertations, regulations, statutes, yearbooks, encyclopedias, and other written sources both printed and electronic, "or in other words another, literature study is a study whose research object is in the form of literature works in the form of journals, book articles in the mass media, and statistical data "(Dana Riska Buana, 2020). This literary will be used to answer the investigative problems proposed by the author, which in this case is the impact of the Coronavirus COVID-19 on global shipping and the maritime industry in Indonesia as well as prevention and handling efforts by the Indonesian government based on WHO and IMO recommendations. "The nature of the study carried out is descriptive analysis, namely research that seeks to describe a symptom, event and incident that occurs at present, where the researcher tries to photograph the events and incidents that are the center of attention and then describe them" (Nana Sudjana and Ibrahim, 1989).The aim is to provide education and understanding to readers of the phenomena that occur.As for this research design, the author provides a visualization picture into the flowchart as follows:



3. DISCUSSION

3.1 Impact of the Coronavirus COVID-19 on Global Shipping.

When the Coronavirus was just entering its initial phase, when the outbreak was still raging, Wuhan and China, the impact of the logistics sector and the economy, in general, was already very much felt. Wuhan is on the Yangtze river route which is quite busy with the flow of goods. More than 80% of China's river traffic travels through the Yangtze River, that is, there is a cargo volume of about 1.5 million containers from Wuhan alone. The surrounding area is home to important commodities such as coal, steel, crude oil, and fertilizer. The implication is that the distortion of economic activity in this city is enough to disrupt the supply chain which affects China's economy. Furthermore, with China's very strong dominance in the global economy, the impact on the world economy will be felt very quickly.

Since entering the World Trade Organization (WTO) in 2001, global news of China's container shipments has grown from only 10% in 2003 to 14% in 2019. Meanwhile, the important portion of dry bulk commodities to world volume has jumped very sharply from only 11 % to 34% over the same period. Dry bulk commodities are raw materials used in the subsequent production process including grains, metals, and energy. Of the total dry bulk commodities, China's portion in the global market is very dominant. China shipped 20% chemicals, 18% gas, and 16% crude oil in 2019. It can be implemented that the turmoil that occurs in China will have an impact on the upstream and downstream parts of the global production chain.

3.1.1 Decrease in Container Demand

The transportation sector is one of the leading sectors affected by this economy's economy. The delays from logistical activities in the past two months have reduced the volume of container cargoes at China's regional ports, including Hong Kong by more than 6 million Twenty Equivalent Units (TEUs). As a result, up to the third week of January, the number of ship calls at China's main ports had decreased by 20%. This sluggishness is thought to erode the acceptance of global container companies by sailing empty due to a lack of cargo. Assuming a cargo reduction of US $ 1.7 million and an average tariff of US $ 1,000 per TEUS, the losses of global container companies were assessed to range from the US $ 1.7 billion to the first quarter of 2020. (HIS Markit, Caixin, China Customs) It can be seen that the PMI slumped to the lowest position in 2020 after previously being at the lowest position in 2009. This significant drop in PMI is an indication of a decline in activity in the manufacturing sector as a whole which has an impact on economic conditions in China and affects global economic conditions.

Figure 3.1.1A, Caixin China PMI and Export Growth

Figure 3.1.1B, Correlation Between Left and Right

The additional time to deliver raw materials as a result of the Coronavirus, it has disrupted the supply chain. As a result, purchasing activity has also declined sharply.

3.1.2 Decreasing Demand for BDI Dry Bulk Cargo

The indicator depicted from the Baltic Dry Index (BDI) also implies the same sluggishness. BDI describes the market balance between the demand and supply of commodities. This indicator can be used to explain the level of the global economy because it acts as a proxy for the volume of trade in coal, nickel, bauxite and other metals. These commodities are generally shipped by dry bulk cargo (Capesize, Panamax, and Supramax types).

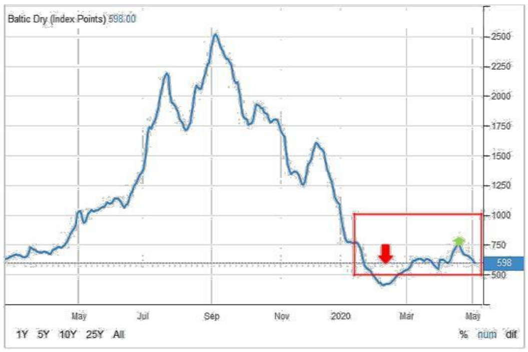


Figure 3.1.2, Baltic Dry Index (BDI)

Based on the Trade Economy, it is known that there has been a decrease of around 635 points due to the influence of COVID-19. However, there was an increase again for the first time after the last three months, namely, in April, there was an increase of 700 points. This is because activity in China has gradually improved after the pandemic.

As we know, China is the largest contributor, about 40% of the total global dry sea trade. This has had a significant impact on global economic conditions as a whole.

3.1.3 Decrease in Demand for BDI Dirty Tanker

All BDI indicators are based on ship types, which experienced a drastic decline in the third week of February 2020. These findings indicate that the global manufacturing industry sector continues to decline. BDI for all types of bulk carriers and commodities fell sharply by 60% from 1090 at the end of December 2019 to only 465 in the third week of February 2020. Likewise, BDI dirty tankers (oil) and clean tankers (Liquid Natural Gas / LNG) decreased. by 45% and 25%. The global economic slowdown is being seen by ordering cargoes based largely on the sluggishness in the manufacturing and construction sectors.

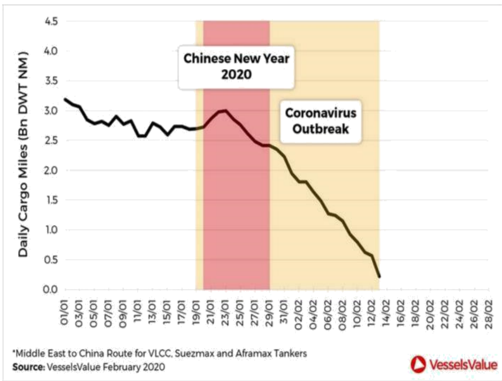


Figure 3.1.3A, China Crude Oil Tanker Demand 2020

The outbreak of the Coronavirus has proven that the level of dependence of the shipping industry on the Chinese economy is so high. If industrial activities in China stop operating, the sailing industry will stall, not only in the global supply chain sector but will also have a good impact on manufacturing, transportation, transportation, or seaport activities. Based on data from the sustainable world port, it reports several impacts that have occurred in several ports due to the Covid-19 pandemic as shown in the Figure below:

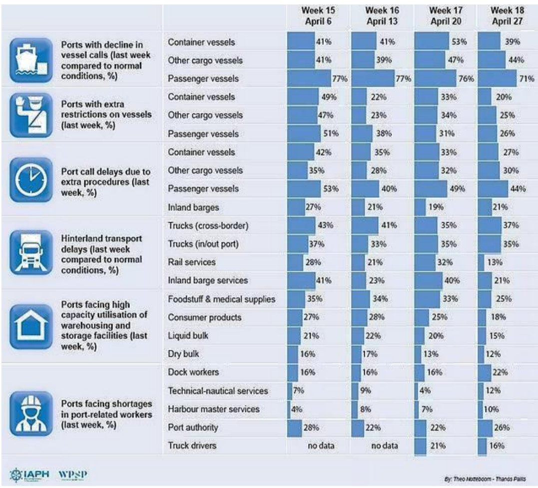


Figure 3.1.3B ,. World Ports Sustainability Program Dashbord (WPSP) *Barometer of the Economic Impact of the WPSP COVID19 Port*

The data above shows a barometer of the economic impact of the ports of 76 ports in the world due to the pandemic. It was reported that seventy-six ports surveyed in this WPSP Port Economic Impact Barometer World Report, reported a relatively stable situation compared to previous weeks, with a mention of improvements in some areas of port continuity.

3.2 The Impact of the Coronavirus COVID-19 on the Maritime Industry in Indonesia

3.2.1 National Shipping Sector

The national service sector is facing tough challenges with the outbreak of the Covid-19 pandemic. At least 4 aspects were affected in the sailing business sector due to the Coronavirus outbreak, namely (INSA, 2020):

a. Decrease in Export and Import Cargo Volume

The decline in cargo volume, both on the affected exports and imports, such as to China, decreased by 14-18 percent and had an impact on other destination countries, such as Singapore and South Korea. Likewise, domestic cargoes, especially cargoes that support export-import and national distribution, fell by 5-10 percent.

b. Clearance Process At The Port

The clearance process at the port took longer due to the spraying of ship disinfectants, health checks of ship crews, and inspection of ship travel history. This has an impact on the addition of ship operating costs.

c. Decreased Performance as a Result of Physical Distance and Work from Home (WFH)

The physical distance and work from home policies also have an impact on the performance of agencies because many limits working hours including operational personnel within the Directorate General of Transportation in sub-districts related to shipping certificate management and portability. d. Ship Docking Issues National shipping has also experienced boat docking. This is because many shipyards have reduced the number of workers in the field to minimize the spread of Covid-19.

As a result, maintenance work for ships that are docked is hampered for how long, and other ships have had to queue for a long time to dock in the last two months. In addition, important ship spare parts from China are constrained so that they take longer and are more expensive. Conditions that are hitting the national conflict sector at this time will also have an impact on the decline in the performance of other related industries, such as the performance of logistics, insurance, shipbuilding, the ship spare part industry to the seafarers' HR education agency.

3.2.2 Shipyard Sector Ship

The condition of the shipyard industry in the last few months has been dire. This is because most ship components still depend on imports, while the rupiah exchange rate against the United States dollar continues to decline13. Shipyard productivity also decreases with directions to work from home (WFH) or physical distance from the government. Apart from productivity, it also corrects the flow of logistics which makes it transmitted to the ship's demand cycle.

3.2.3 Port Sector

The impacts that have an impact on the sports sector due to the Covid-19 pandemic in Indonesia, namely:

a. Termination of Port Operations

PT Pelabuhan Indonesia II (IPC) to stop the operation of 3 of the 5 passenger terminals it manages. The closure was carried out because the ships serving passengers in the three ports were temporarily serving to reduce the spread of the Coronavirus (Covid-19). The three passenger terminals that are temporarily closed are the passenger terminal at Tanjung Pandan Belitung Port and Pangkal Balam Bangka Port, as well as the Boom Baru Port passenger terminal in Palembang, South Sumatra. Meanwhile, the other 2 passenger terminals are still operating at Tanjung Priok Port and Pontianak Port. This decision was taken by the ship manager as an effort to support the Regional & Provincial Government programs in preventing the spread/prevention of Covid-19.

b. Delays in Port Strategic Projects

"Strategic projects in the port sector that are currently being worked on or undertaken to be carried out by BUMN PT. It is also feared that Pelabuhan Indonesia II / IPC will not be completed according to target "(ISP, 2020). As is known, currently PT Pelindo II is completing several projects, including the construction of the Kijing Terminal (West Kalimantan), the completion of the Cilincing-Cibitung toll road project, as well as the follow-up to the New Priok project, both the completion of the 57-meter area project NPCT1 and CT2. and CT3. With the current massive effect of the Coronavirus Covid-19, the completion of these projects may be delayed. Based on the above discussion, it can be seen that there is a national level of sluggishness in the maritime sector in Indonesia. This is also supported by empirical data from Samudera Indonesia operations (SMDR). Data for January and February show a downward trend in trading volume. "Preliminary figures show that the SMDR port in Tanjung Priok recorded a 10% reduction in cargo volume when calculated on a year-on-year (YoY) basis compared to the same month in 2019" (Harya S. Dillon, 2020).

In terms of ship operations, the volume of outgoing cargo (outgoing cargo) was 17% less while the volume of incoming cargo (incoming cargo) was 14% less until the fourth week of January 2020 compared to the same period in 2019. Some things that must be anticipated are:

a. Preparing for the delay in the manufacturing supply chain in the coming months.

b. Some of the trade contracts to and from China were canceled or to the second semesterof 2020. This phenomenon affects the demand and offer of bids given China's share as a producer and a consumer.

Based on the explanation aside, it can be concluded that the Covid-19 pandemic has had a real impact, both on global shipments which affect supply chain conditions in general, as well as the maritime industry in Indonesia in particular. To ensure the sustainability of activities in the Indonesian maritime industry which is as difficult as it is today, efforts are needed to prevent and handle the spread of the 2019 Coronavirus in Indonesia by international safety standards.

3.3 World Health Organization (WHO) Recommendations.

The World Health Organization or the World Health Organization (WHO) has provided eight important recommendations to the Indonesian government in the context of handling cases of the spread of Covid-19. WHO gave recommendations for handling the Coronavirus to the Indonesian government. Based on the report on the results of the WHO team meeting with the government team, WHO gave considerations to Indonesia in making preventive policies. Discussion with WHO Jakarta Monitoring Covid-19, "The World Health Organization gives three considerations to the Indonesian government" (Barly Halim, 2020)

a. The health of the population is a top priority for government policy, but the current efforts are still not maximal.

b. Efforts to reduce the economic impact so as not to be directed at stimuli that encourage the spread of infection. Such as opening the tap for foreign tourists, but the stimulus for social protection such as the impact on companies, provision of basic goods, and others.

c. Increasing surveillance can capture more suspected cases, but in the medium term, it is more in mitigating economic impacts and international confidence.

In addition, the Indonesian government also provides specific recommendations from WHO:

a. Activate national emergencies and form a Special Team that has the authority to make evidence-based decisions.

b. Extending intensive case detection and contact to see exactly which areas of Indonesia are active transmission;

c. Encouraging the decentralization of Laboratory the capacity, especially in laboratories that have capacity and increase the capacity of existing laboratories. According to Bappenas notes, currently, only the laboratory at Litbangkes is conducting tests. Meanwhile, the Provincial Government of DKI Jakarta, which already has a Covid-19 Test Lab, has not yet the authority to carry out lab tests for cases of virus infection.

d. Announce confirmed cases and submit an immediate contact statement to WHO for analysis and provide advice to the government.

e. Detention options include: dismissing schools; cancel large meetings; travel to public places;

f. Promoting and maintaining distance when socializing, not shaking hands, kissing, or applying other basic protective measures (washing hands and masks).

g. Advise people showing respiratory symptoms to stay at home, isolate themselves, and immediately go to a health care facility.

h. Facilities and infrastructure are needed in large numbers at 132 referral hospitals. These facilities and infrastructure include stocks of Personal Protective Equipment, ventilators, respirators, and materials other medical facilities. In addition, it needs body bags and safe burial procedures for everyone who dies from respiratory infections.

3.4 Recommendations of the International Maritime Organization (IMO)

"The International Maritime Organization (IMO) issued a number of recommendations, following the World Health Organization's (WHO)" Global Emergency "declaration of the Coronavirus (2019-nCoV) outbreak. WHO on January 30, 2020, declared the outbreak of the Coronavirus (2019-nCoV) a global emergency situation or Public Health Emergency of International Concern (PHEIC)(Maritime Journal, 2020)

The Global Emergency Situation WHO refers to is an extraordinary event that risks threatening the public health of other countries through cross-border disease transmission, thus requiring a coordinated international response. However WHO does not guarantee travel or trade between countries, based on the most current available information. IMO then issues recommendations to all IMO Member States, seafarers, and sailing companies in two circular letters. IMO recommendations are prepared with reference to recommendations developed by (WHO) and the Division of Health and Safety and Occupational Health Management (DHMOSH) of the United Nations. IMO's recommendations include:

a. "*Circular No.4203 Novel Coronavirus (2019-nCoV) Contains information and guidance on precautionary measures that must be taken for the risks for delegates holding meetings at IMO after the recent coronavirus outbreak*(IMO, 2020)

b. "*Circular No.4204 Novel Coronavirus (2019-nCoV) Contains information and guidance on precautions to be taken for the risks fired by sailors, passengers and others on board "*(Additional IMO, 2020)

IMO also recommends following other additional suggestions, including:

- o *International Maritime Health Association (IMHA) advice for shipping companies*
- ○ *Novel Coronavirus US Cost Guard (USCG) Preventive measure*

Recommendations by IMO to the Member States, seafarers and shipments in detail are as follows:

Table 1. International Maritime Organization Circular (IMO)

No	Surat Edaran IMO	Tanggal Rilis	Saran
1.	Surat Edaran No.4203. Add 1	12 Februari 2020	Informasi dan panduan itu tindakan pencegahan yang harus diambil untuk meminimalkan risiko kepada delegasi
2.	Surat Edaran No.4204 / Add.1	19 Februari 2020	Implementasi dan Pelaksanaan dari instrumen IMO yang relevan
3.	Surat Edaran No.4204 / Add.2	21 Februari 2020	Pernyataan Bersama IMO-WHO tentang Tanggapan terhadap Wabah COVID-19
4.	Surat Edaran No.4204 / Add.3	2 Maret 2020	Pertimbangan operasional untuk mengelola Kasus COVID-19 / wabah di kapal
5.	Surat Edaran No.4204 / Add.4	5 Maret 2020	Panduan bagi operator kapal untuk perlindungan kesehatan pelaut
6.	Surat Edaran No. 4204 / Add.5	2 April 2020	Panduan terkait sertifikasi pelaut dan personel kapal penangkap ikan
7.	Surat Edaran No.4204 / Add.6	27 Maret 2020	Daftar rekomendasi awal untuk Pemerintah dan relevan Nasional otoritas di fasilitasi maritim perdagangan selama pandemi COVID-19
8.	Surat Edaran No.4204 / Add.7	3 April 2020	Panduan tentang penundaan tak terduga dalam pengiriman kapal
9.	Surat Edaran No.4204 / Add.8	14 April 2020	Video meeting dengan kontrol Port State (PSC)
10.	Surat Edaran No.4204 / Add.9	16 April 2020	Pernyataan Bersama IMO-WCO tentang integritas dari rantai pasokan global selama Pandemi covid-19
11.	Surat Edaran No.4204 / Add.10	22 April 2020	Pernyataan Bersama IMO-WHO-ILO tentang medis sertifikat pelaut, sanitasi kapal sertifikat dan perawatan medis pelaut dalam konteks pandemi COVID-19
12.	Surat Edaran No.4204 / Add.11	24 April 2020	Coronavirus (COVID 19) - Pedoman EC aktif perlindungan kesehatan, pemulangan dan perjala nan pengaturan untuk pelaut, penumpang dan orang lain di dalam pesawat Kapal
13.	Surat Edaran No.4204 / Add.12	27 April 2020	Coronavirus (COVID 19) - Deklarasi oleh Pelab Pihak uhan berwajib Meja Bundar (PAR) anggota dalam pandangan COVID-19 global Situasi

IMO Member States requests for the closeness of all stakeholders in their countries (companies, managers, crew agents, etc.) to disseminate the above IMO circular. IMO wants to ensure that the entire global maritime community receives accurate and relevant information about the Coronavirus Covid-19 outbreak and measures to reduce the risk of exposure to the virus, especially those on ships sailing between ports in countries that are affected by the Coronavirus. The attitude of the Indonesian Government is to take action to limit the risk of spreading Coronavirus, without risking international traffic of goods which is in line with the recommendations of the IMO and WHO.

The consequence is that the Ministry of Transportation, in this case, the Directorate General of Sea Transportation (DJPL), is ready to serve IMO and WHO recommendations regarding monitoring and prevention of the entry of the Covid-19 Coronavirus into the country, especially the spread via international shipping routes and ship transportation. Other efforts that were also made were implementing social distancing and working from home (WFH) recommendations.

4. CONCLUSION

The outbreak of Covid-19 has proven how highly dependent seabed trade and global shipping are on China's economy. This is because China has become a role-playing player, which contributes more than 40% of the global dry sea trade. If industrial activities in China stop operating, the industry will become trapped, global supply chains will be affected, and will have a serious impact on the manufacturing, transportation, or sports activities. The real impact of the Coronavirus pandemic on the maritime industry in Indonesia occurs in 3 main sectors, namely, the national shipping sector, the shipbuilding sector, and the ports sector. Meanwhile, to maintain the sustainability of maritime activities and prevent Covid-19,

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ANALYSIS OF AIR POLLUTION LEVEL DUE TO EXHAUST GAS EMISSIONS FROM KRI IN THE KOARMADA B

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ABSTRACT

Exhaust gas from ships is a source of air pollution, which has a very detrimental impact on the environment and living things. Global warming, storms, drought, floods, melting of the north and south polar ice which causes sea levels to rise then causing tidal flooding, forest fires, and disruption of human health, are the impacts and dangers of air pollution. Exhaust gas emissions from KRI operations contribute to air pollution. Based on these conditions, the authors feel it is important to conduct research to determine the level of exhaust emissions so that they can be used as a reference for the Indonesian Navy's policy in supporting the Indonesian government's efforts to prevent air pollution. The research was conducted using a mix methods of quantitative and qualitative. The numerical analysis approach by calculating the value of KRI exhaust emissions is carried out then the results of the calculations are analyzed using a descriptive qualitative analysis approach. From the research results, it was found that 87.5% of KRI had exceeded the allowable exhaust gas emission limit, while only 12.5% were still within the tolerance limit.

Keywords: *Exhaust Emission, Air Pollution*

1. INTRODUCTION

Exhaust gas from ships is one of source air pollution, which has a very detrimental impact. The impact of pollution is a very serious threat to the environment and living things. Exhaust gas emissions from ship activities, including the operational activities of KRI, contribute to the increasing concentration of pollutants, including carbon dioxide, nitrogen oxides, sulphur dioxide, petroleum hydrocarbons, and particulars, if not controlled, will accelerate the increase. The concentration of gases in the atmosphere causing global warming.

Global warming occurs when the earth's global average temperature or surface increases. The cause of this is the result of air pollutants with green house gases gathering on the atmosphere and then absorbing sunlight and solar radiation that bounces off the earth's surface. This radiation should normally go to outer space, but due to pollutants, radiation and sunlight are trapped in the atmosphere. This phenomenon is known as the greenhouse effect as the cause of global warming. The example of gases that cause the greenhouse effect are Carbon Dioxide (CO2), Nitro Oxide (NOx), Sulphur Oxide (SOx), Methane (CH4), Chlorofluorocarbon (CFC), Hydrofluorocarbon (HFC).

Based on BMKG data, in 2019, there was an increase in temperature in Indonesia, the average about of 0.58 ° Celsius. This makes 2019 the second hottest year since the range of temperature increases in 1981-2010 after 2016 (BMKG, 2021). The World Meteorological Organization (WMO) revealed that there was an increase temperature in the global, the average temperature about of 1.1 ° Celsius. United Nations Climate Change And Global Warming report show 2019 to be the hottest year in the past five years. The UN report states that the average global temperature in 2015-2019 is in the warmest path (CNN, 2021). This increase resulted in many natural disasters due to rising earth temperatures during 2019, such as storms, drought, floods, melting of the north and south polar ice, which caused sea levels to rise, causing tidal flooding and forest fires. Another impact on the maritime security sector, according to Basil Germond (2019), states that climate change due to global warming affects the level of maritime security of a country's territory.

One of the sources of air pollution is the maritime sector, in which there are marine operational activities. Indonesia's maritime transportation network is significantly more advanced than air transportation, with nearly 90% of international trade being conducted by sea (Dijk et al., 2015). According to Dong (2015), the sea transportation mode is the prima donna in the business world because of its high carrying capacity and more competitive costs than other modes of transportation. Based on business economic factors, it makes Indonesian waters crowded and congested. Moreover, of the 9 (nine) choke points that are owned by the world, 4 (four) of them are in Indonesia as an international shipping route, namely the Malacca Strait, Makassar Strait, Sunda Strait, and Lombok Strait. This condition requires the Indonesian Navy to deploy the KRI fleet as its SSAT to secure the territorial waters of the Indonesian State in the face of the hectic Indonesian maritime transportation route.

Based on the conditions mentioned above, one of the sources of air pollutants in the maritime world, which in this case is the operational activities of ships, so the Indonesian Navy is also a potential source of air pollutants. Thus, this is what underlies the importance of this research being carried out to determine the level of KRI exhaust emissions to be used as a reference for the Indonesian Navy's policy in supporting the Indonesian government's efforts to prevent air pollution.

To support the research, this paper has many works of literature, for the example, paper with the title: The Analysis of Greenhouse Gas Emissions Mitigation: A System Thinking Approach (Case Study: East Java) (Jatmiko, Suryani, & Octabriyantiningtyas, 2019), Fuel Consumption and Vehicle Emission Models for Evaluating Environmental Impacts of the ETC System (Weng, 2015), System Dynamics Modeling For Urban Energy Consumption And CO2 Emissions: A Case Study Of Beijing China (Feng, Chen, & Zhang, 2013), Methodologies for estimating air pollutant emissions from ships (Trozzi C., Vaccaro R., 2006), Climate change and maritime security (Basil Germond, 2019), Strategies to Reduce Air Pollution in Shipping Industry (Han, Chul-hwan, 2010).

In this paper, the writer uses mixed methods (quantitative and qualitative methods). For quantitative analysis, by calculating the level of KRI exhaust emissions in Koarmada B (not the real name of location). The results of the calculations are analyzed, and then a descriptive qualitative by risk management analysis approach is carried out. This paper is organized into several parts; the second part is the material and method, the third part is the research results, the fourth part is the discussion, and finally, the fifth part is the conclusion.

2. MATERIAL AND METHOD

2.1 Air Pollution Hazard

Exhaust gas emissions as a cause of air pollution, in excess concentrations, can have a detrimental impact on human life, causing health problems and damage to the environment. Some of the negative impacts that exhaust gas emissions with excess concentrations can cause include:

a. CO2 (Carbon Dioxide)

The remainder of the combustion is in the form of CO2 or also known as carbon dioxide, which is a greenhouse gas that can cause environmental damage. Indeed, CO2 emissions from shipping activities cover estimated to account for 3-5% of total CO2 emissions (IMO , 2009) . In annexe , estimates show that in 2050 maritime transport will be for 15% of overalls

b. Sulphur Dioxide (SO2)

Pollution caused by sulphur oxides is caused by sulphur components in the form of a colourless gas, namely Sulphur Dioxide (SO2) and Sulphur Trioxide (SO_3), both of which are known as Sulphur Oxides (SO_x). The impact of SO_x pollutants on humans is the irritation of the respiratory system. Several studies have shown that throat irritation can occur at SO2 concentration levels of 5 ppm or more; there are even more sensitive individuals where irritation can occur at concentrations of 1-2 ppm. SO_2 is often referred to as a pollutant that is harmful and dangerous to human health, especially in the elderly and people with chronic diseases of the cardiovascular, respiratory system.

c. Carbon Monoxide (CO)

Carbon monoxide is a compound that is odorless, tasteless, and at normal air temperature conditions in the form of a colorless gas. Unlike other compounds, CO has the potential to be harmful because it can form strong bonds with the blood pigment, namely hemoglobin.

d. Nitrogen Dioxide (NO_2)

NO_2 is toxic, especially to the lungs NO_2 levels above can kill most experimental animals , and 90% of these deaths are caused by symptoms that arise, namely pulmonary edema (pulmonary edema). NO_2 levels of 800 ppm can result in 100% of the deaths in the tested animals in less than 29 minutes. Experiments with the use of NO_2 at a concentration level of 5 ppm within 10 minutes tested on humans resulted in the person experiencing shortness of breath.

e. Hydro Carbon (HC)

The hydrocarbons in the air will react with other materials and form a new band called Polycyclic Aromatic Hydrocarbon (PAH). This substance is found in many industrial and traffic-heavy areas. If the PAH substance enters the lungs, it can cause injury and trigger the growth of cancer cells.

f. Suspended Particulate Matter (SPM)

In general, the particulate dust size of about 5 microns is an airborne particulate that is harmful to humans because it can be inhaled directly into the lungs and settles in the alveoli. However, it does not mean that particulate sizes of more than 5 microns are harmless; instead, larger particulates can disrupt the upper respiratory system causing serious irritation symptoms.

g. Lead (Pb)

High levels of lead (Pb) in the air can interfere with the formation of red blood cells. Early symptoms due to poisoning are shown by disruption in the function of the enzymes that form red blood cells, which in turn leads to symptoms of other health problems such as anemia, kidney damage, brain disorders, and others, exacerbated by the occurrence of lead (Pb) poisoning. Accumulative.

In addition to several negative impacts that have a direct impact on human health, exhaust emissions also harm the environment, such as global warming, which has a very broad effect, including causing storms, droughts, floods, melting of the north and south polar ice which causes sea levels to rise—causing tidal flooding, to forest fires. In addition, emissions from ships are transported into the atmosphere for several hundred kilometers, and can thus cause air quality problems on land even if they are released at sea. This pathway is particularly relevant for the deposition of sulfur and nitrogen compounds (Cofala et al., 2007). Another impact on the maritime security sector, according to Basil Germond (2019), states that climate change due to global warming affects the level of maritime security of a country's territory.

2.2 Calculation of Exhaust Gas Emissions According to Marpol Annex VI

The calculation of exhaust gas emissions on ships uses the ship fuel consumption calculation approach by referring to the. calculation method used according to Marpol 73/78 Annex Vl. The International Convention for the Prevention of Pollution from Ships (MARPOL 1973/1978) represents the. main IMO Convention. currently in force regarding. the protection of the marine environment. The MARPOL 1973/1978 Convention represents the most relevant regulation on marine pollution. In 1997, air pollution was included in Annex VI, setting limits on sulphur oxide (SOx) and nitrogen oxide (NOx) emissions from ship exhausts and prohibiting deliberate emissions of ozone-depleting substances. Annex VI was ratified by 60 contracting States with 84.04% of the world's merchant shipping tonnage. It entered into force on 19 May 2005. In 2008 Annex VI was amended (MEPC 58/23/Add.1). The revised text establishes more stringent emission requirements for ships that operate in designated coastal areas where air quality problems are acute, entered into force on 1 July 2010.

Tier I-lII is an emission standard commonly used in IMO. IMO divides the formulation of NOx emissions into 3 calculation methods by classifying them based on the year of manufacture of the engine with the terms Tier l, Tier ll, and Tier lll. The division into 3 Tier, namely:

a. Tier I: diesel engines (> 130 kW) installed on ships built on or after January 1, 2000, and before January 1, 2011.

b. Tier II: diesel engines (> 130 kW) installed on ships built on or after January 1, 2011, and before January 1, 2016.

c. Tier III: diesel engines (> 130 kW) installed on ships built on or after January 1, 2016.

For calculating the value of pollutant emission, it is necessary to know the NOx Threshold Value and the Pollutant Emission Factor. The NOx threshold values regulated in the Marpol 73/78 Annex Vl regulations amended in October 2008 are grouped based on engine speed (rpm) are shown in table 2.1. Pollutant emission factors on ships using marine gas oil or marine diesel oil are shown in table 2.2. According to Carlo Trozzi (2006) in the International Transport and Environment seminar held in France, to calculate the emission value of pollutants with a numerical approach, we can use the equation:

$$E_i = \sum_m (FC_m \, x \, EF_{i,m}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.1)$$

Where:

E_i = Pollutant Emissions i (kg)
FC_m = Fuel consumption (ton/hour)
$EF_{i,m}$ = Pollutant Emission Factor (kg/ton)
m = Fuel type

Table 2.1 Pollutant Emission Threshold Value

Regulation	NO_x limit	(revolution per minute)
Tier I	17 g/kWh	$n < 130$
	$45 \times n^{-0.2}$ g/kWh	$130 \le n < 2000$
	9,8 g/kWh	$n \ge 2000$
Tier II	14.4 g/kWh	$n < 130$
	$44 \times n^{-0.23}$ g/kWh	$130 \le n < 2000$
	7.7 g/kWh	$n \ge 2000$
Tier III	3.4 g/kWh	$n < 130$
	$9 \times n^{-0.2}$ g/kWh	$130 \le n < 2000$
	2 g/kWh	$n \ge 2000$

(Source : MARPOL IMO ANNEX VI)

Table 2.2 Pollutant Factor Value

	Code	Name			
NFR Source Category	1.A.3.d.i 1.A.3.d.ii 1.A.4.c.iii 1.A.5.b	International navigation National navigation Agriculture / forestry / fishing: National fishing Other, mobile (including military, land based and recreational boats)			
Fuel	Marine diesel oil/marine gas oil (MDO/MGO)				
Not applicable	HCH				
Not estimated	NH3				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NOx	78.5	kg/tonne fuel	0	0	Entec (2007). See also note (2)
CO	7.4	kg/tonne fuel	0	0	Lloyd's Register (1995)
NMVOC	2.8	kg/tonne fuel	0	0	Entec (2007). See also note (2)
SOx	20	kg/tonne fuel	0	0	Note value of 20 should read 20*'S'. Lloyd's Register (1995). See also note (1)
TSP	1.5	kg/tonne fuel	0	0	Entec (2007)
PM10	1.5	kg/tonne fuel	0	0	Entec (2007)
PM2.5	1.4	kg/tonne fuel	0	0	Entec (2007)
Benzo(b)fluoranthene	0.01	g/tonne fuel			average value
Benzo(k)fluoranthene	0.01	g/tonne fuel			average value
Benzo(a)pyrene	0.002	g/tonne fuel			average value
Indeno(1,2,3-cd)pyrene	0.001	g/tonne fuel			average value
Pb	0.13	g/tonne fuel	0	0	average value
Cd	0.01	g/tonne fuel	0	0	average value
Hg	0.03	g/tonne fuel	0	0	average value
As	0.04	g/tonne fuel	0	0	average value

(Source : EMEP/EEA Air Pollutant Emission Inventory Guidebook, 2019).

2.3 Risk Management

Risk management is defined as a science that discusses how an organization determines its size in mapping an existing problem by placing various management approaches that are carried out comprehensively and systematically (Fahmi, 2010). Risk is uncertainty about future events, or risk is a form of uncertainty about a situation that will occur later (in the future) with decisions taken based on various considerations at this time (Griffin, 1996).

(Bhoola, 2014) divides risk response into four strategic forms, namely avoidance, transference, mitigation, and acceptance. Briefly, it can be explained as follows:

a. Avoidance

Avoidance strategies are carried out by reducing or eliminating activities that have a high likelihood of risk by making it more difficult for these risks to occur. Avoidance can also be done by doing work by avoiding risky activities but with the same ultimate goal.

b. Transference

Transference strategy is carried out by transferring part or all of the risk to third parties. Usually, the transferred risk is low but has a considerable financial effect. In the process, it is necessary to carry out a more in-depth assessment of the third party regarding managing work and the risks that may occur.

c. Mitigation

Mitigation strategies are carried out by analyzing the potential and impact of risks, then planning to reduce the possibility and effects of these risks within the company's capabilities.

d. Acceptance

Realizing that some risks still exist, the acceptance strategy is carried out by accepting existing risks by providing allocations or leeway in schedules and costs, but these allocations need to be ensured and monitored so that they do not exceed the planned value.

OHSAS 18001 applies risk control guidelines specified in the K3 field with control groupings, namely elimination, engineering control, substitution, administrative control, and the use of Personal Protective Equipment (PPE). Following the objectives of Risk Control, namely to minimize the level of risk from an existing hazard, according to the AS / NZS 4360 (2004) standard, risk control is generally carried out with the following approach:

a. Avoid risk (risk avoid)

b. Reducing the possibility of this happening (reduce likelihood).

c. Reducing the consequences of events (reduce consequence)

d. Transfer of risk to other parties (risk transfer)

e. Bear the remaining risk (residual risk).

2.4 Method of Research

This research following step which is shown in the flow chart diagram shown in figure 2.

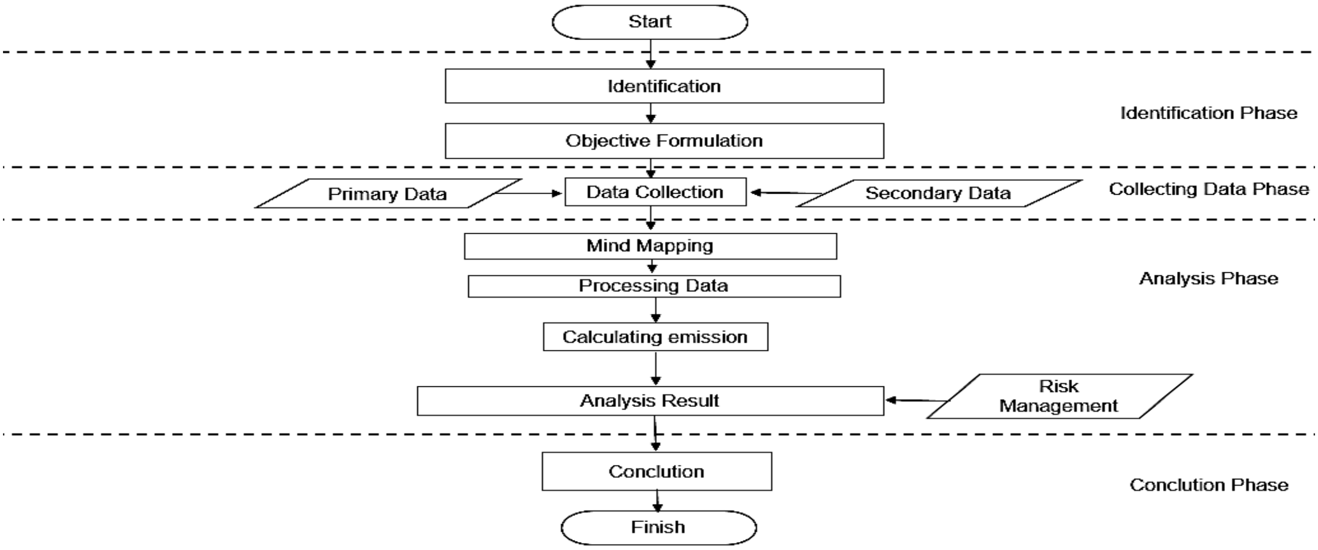

Figure 2. Research Flowchart

3. RESULT AND DISCUSSION

3.1 Data Collection

Analyzing process the main problems in this study, data collection includes: a. Primary data collection includes data on engine characteristics, year of manufacture, and its relation to fuel use and exhaust emissions produced;

b. Secondary data collection includes data from related sources.

In collecting data to obtain information, literature studies and interviews with related parties were carried out to obtain the required data. To maintain data confidentiality, the name KRI is

In

disguised but does not change the essence of the importance of presenting the data.

In table 3.1, fuel consumption data is presented from the KRI element Koarmada B.

Table 3.1 Fuel Consumption Data

NO	NAME OF KRI	POWER	FUEL CONSUMPTION		NO	NAME OF KRI	POWER	FUEL CONSUMPTION		NO	NAME OF KRI	POWER	FUEL CONSUMPTION	
		(KW)	l/h	Kg/h			(KW)	l/h	Kg/h			(KW)	l/h	Kg/h
1	A	781	85	72,25	21	U	420	84	71,4	41	PP	148	30	25,5
2	B	781	85	72,25	22	V	495	75	63,75	42	QQ	148	62,5	53,125
3	C	500	62,5	53,125	23	W	495	75	63,75	43	RR	200	80	68
4	D	500	104,79	89,0715	24	X	495	75	63,75	44	TT	200	80	68
		292	62,5	53,125	25	Y	232	50	42,5	45	UU	100	35	29,75
5	E	500	78	66,3	26	Z	312	50	42,5	46	VV	100	35	29,75
6	F	500	104,79	89,0715	27	AA	232	50	42,5	47	YY	200	50	42,5
7	G	500	62,5	53,125	28	BB	232	62,5	53,125	48	XX	140	25	21,25
		715	104,16	88,536	29	CC	232	62,5	53,125	49	YY	140	25	21,25
8	H	500	100	85	30	DD	256	45	38,25	50	ZZ	125	25	21,25
9	I	600	110	93,5	31	EE	500	80	68	51	AAA	125	25	21,25
10	J	500	100	85	32	FF	500	80	68	52	BBB	168	35	29,75
11	K	500	124	105,4	33	GG	292	40	34	53	CCC	150	35	29,75
12	L	292	54,16	46,036	34	HH	292	40	34	54	DDD	150	35	29,75
13	M	292	54,16	46,036	35	JJ	292	40	34	55	EEE	292	95	80,75
14	N	292	54,16	46,036	36	KK	164	35	29,75	56	FFF	159	62,5	53,125
15	O	292	54,16	46,036	37	LL	164	35	29,75	57	GGG	125	25	21,25
16	P	292	50	42,5	38	MM	64	30	25,5	58	HHH	500	80	68
17	Q	313	50	42,5	39	NN	64	30	25,5	59	III	800	92	78,2
18	R	313	50	42,5	40	OO	64	30	25,5	60	JJJ	270	62,5	53,125
19	S	292	50	42,5	43	RR	200	80	68	61	KKK	500	42	35,7
20	T	420	84	71,4	44	TT	200	80	68	62	LLL	300	50	42,5
										63	MMM	500	58	49,3
										64	NNN	500	42	35,7

3.2 Data Processing

Direct measurement of exhaust emission levels is considered impractical or even impossible to do for every pollutant source due to the absence of a ship exhaust emission measurement tool within the Indonesian Navy. Therefore an approach is formulated to estimate the amount of pollution load using equation 2.1. For example, the calculations on KRI A and KRI H to get the value of exhaust emissions are carried out in the following steps:

a. Convert fuel consumption from l / h to kg / h

Assuming the density of the fuel used is 0.85 kg / l,

- KRI A : 85 l/h x 0,85 kg/l = 72,25 kg/h
- KRI H : 100 l/h x 0,85 kg/l = 85 kg/h

b. Calculating the value of exhaust gas emissions with a formula

$$E_i = \sum_m (FC_m \; x \; EF_{i,m})$$

With the NOx pollutant factor value according to table 2.2 is 78.5 kg / ton, then,

- KRI A :

E_i = 72,25 x 10^{-3} ton/h x 78,5 kg/ton

= 5,671 kg/h

with 781 kW engine power, the emission value exhaust gas is obtained:

E_i = 5,671 kg/h : 781 kw

= 0,00726 kg/kwh

= 7,26 g/kwh

- KRI H :

E_i = 85 x 10^{-3} ton/h x 78,5 kg/ton

= 6,6725 kg/h

with an engine power of 500 kw the emission value exhaust gas is obtained:

E_i = 6,6725 kg/h : 500 kw

= 0,013345 kg/kwh

= 13,345 g/kwh

c. Calculate emission threshold values

- KRI A :

The engine made in 2014 with an engine speed of 1800 rpm, so Tier II with an emission limit formula is used:

$44 \times n^{-0,23}$ g/kwh

$= 44 \times 1800^{(-0,23)}$ g/kwh

= 7,847 g/kwh

- KRI H :

The engine made in 2007 with an engine speed of 1800 rpm, then the Tier I formula is used with the emission limit formula:

$45 \times n^{-0,2}$ g/kwh

$= 45 \times 1800^{(-0,2)}$ g/kwh

= 10,049 g/kwh

For the other KRI elements, Results of the calculations are presented in the table 3.2.

Table 3.2 Emission Level Calculation Result Data

NO	NAME OF KRI	NOx Emission Value	Limit	NO	NAME OF KRI	NOx Emission Value	Limit
		g/kwh	g/kwh			g/kwh	g/kwh
1	A	7,262003841	7,847657	32	FF	10,676	10,42304
2	B	7,262003841	7,847657	33	GG	9,140410959	7,847657
3	C	8,340625	10,04981	34	HH	9,140410959	7,847657
4	D	13,9842255	10,04981	35	JJ	9,140410959	7,847657
		14,28189212	10,04981	36	KK	14,24009146	8,183737
5	E	10,4091	10,04981	37	LL	14,24009146	8,183737
6	F	13,9842255	10,04981	38	MM	31,27734375	10,42304
7	G	8,340625	10,04981	39	NN	31,27734375	10,42304
		9,720386014	10,04981	40	OO	31,27734375	10,42304
8	H	13,345	10,04981	41	PP	13,52533784	10,42304
9	I	12,23291667	10,04981	42	QQ	28,17778716	8,183737
10	J	13,345	10,04981	43	RR	26,69	10,0498
11	K	16,5478	10,04981	44	TT	26,69	10,0498
12	L	12,37611644	10,04981	45	UU	23,35375	10,0498
13	M	12,37611644	10,04981	46	VV	23,35375	10,0498
14	N	12,37611644	10,04981	47	YY	16,68125	2,084607
15	O	12,37611644	10,04981	48	XX	11,91517857	8,183737
16	P	11,4255137	10,42304	49	YY	11,91517857	8,183737
17	Q	10,65894569	10,42304	50	ZZ	13,345	10,04981
18	R	10,65894569	10,42304	51	AAA	13,345	10,04981
19	S	11,4255137	10,42304	52	BBB	13,90104167	10,04981
20	T	13,345	10,42304	53	CCC	15,56916667	10,04981
21	U	13,345	10,42304	54	DDD	15,56916667	10,04981
22	V	10,10984848	2,009963	55	EEE	21,70847603	10,04981
23	W	10,10984848	2,009963	56	FFF	26,2283805	10,04981
24	X	10,10984848	2,009963	57	GGG	13,345	10,04981
25	Y	14,38038793	10,42304	58	HHH	10,676	10,42304
26	Z	10,69310897	10,42304	59	III	7,673375	8,183737
27	AA	14,38038793	10,42304	60	JJJ	15,44560185	10,42304
28	BB	17,97548491	10,42304	61	KKK	5,6049	7,847657
29	CC	17,97548491	10,42304	62	LLL	11,12083333	10,42304
30	DD	11,72900391	10,42304	63	MMM	7,7401	10,04981
31	EE	10,676	10,42304	64	NNN	5,6049	7,847657

Based on the data from table 3.2 it can be seen that of the 64 KRIs in Koarmada B, 56 KRIs have passed the allowable exhaust emission limits and only 8 KRI are still within the tolerance value for exhaust gas emission levels or as much as 87.5% of the KRI in Koarmada. B has exceeded the exhaust gas emission limit and only 12.5% is still within the allowable emission tolerance value (Figure 3.1).

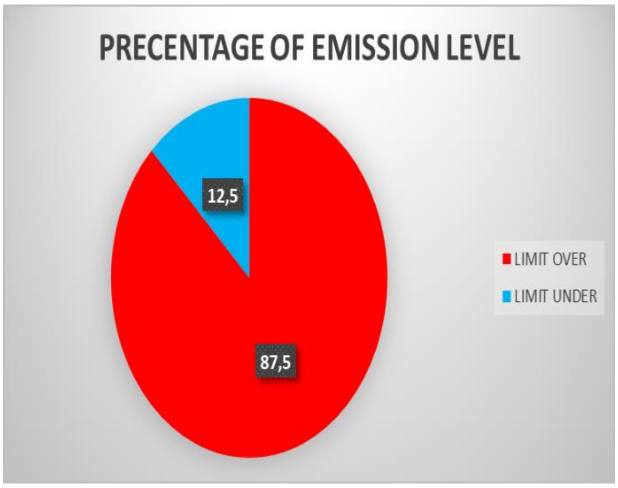

Figure 3.1 Percentage of emission level KRI exhaust gases

Based on the value of exhaust gas emission levels in KRI, most of which have exceeded the permitted emission limits, KRI can be considered as a source of air pollutants. Given that the impact that air pollution can cause is very dangerous for the environment and human health, with a risk control approach, what the Indonesian Navy can do is take risk control steps as a risk response according to the theory presented by Bhoola (2014) where risk response divided into 4 forms of strategy, namely avoid (avoidance), transfer (transference), mitigation (mitigation) and accept (acceptance). The strategy of avoiding risk and transferring risk, in this case, cannot be done because the need for the Indonesian Navy to continue operating is high. As for the transfer strategy, in the context of this risk, it cannot be done because the risk that occurs is not transferable. What can be done in controlling the risk of this case is to mitigate risks by reducing the impact of a higher level of risk, such as using environmentally friendly fuels, replacing conventional engines with modern engines that are more environmentally friendly, providing training to ship crews so they can carry out procedures operation and maintenance of machines. Furthermore, if risk mitigation steps have been taken, with the existing risk severity, a relatively smaller risk can be accepted. However, steps and strategies in risk control need to be carried out through further studies adapted to the situation and conditions in the Indonesian Navy so that maximum results can be obtained to obtain the best solution in risk mitigation.

4. CONCLUSIONS

Based on the results of the research that has been done, it can be concluded that most of the KRI in Koarmada B has exceeded the allowable exhaust gas emission limit so that it can be considered that KRI is one of the sources of air pollutants. Considering the impact of the dangers that can arise from air pollution, which is damaging to the environment and health, the Indonesian Navy needs to carry out risk control as a concrete step to reduce air pollution due to KRI exhaust emissions. Several strategies need to be made to deal with this.

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FIELD III
POLICY AND STRATEGY

THE INFLUENCE OF WORK CULTURE AND COMMUNICATION ABILITY TO THE PERFORMANCE OF SHIPS CREW IN SURABAYA NORTH QUAY

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ABSTRACT

In the work environment on the ship, the crew is expected to have a work culture and the ability to communicate using good English to achieve good performance on the ship. The purpose of this study was to determine how positively and significantly the influence of work culture and the ability to communicate using English to the performance of the crew. The method used by distributing questionnaires to respondents, namely crew members with quantitative analysis methods, namely multiple linear regression analysis, t test, F test and determination test so that it can be seen the effect of work culture and the ability to communicate on the performance of the crew. The results obtained in this study, there is a positive influence between work culture and communication skills on the performance of the crew. In the end, it is hoped that this research will give a reference for shipping companies, ship crews and related parties.

Keywords: Work Culture, Communication Ability, Crew Performance.

1. Introduction

In the work environment there are values that have become habits and are related to the quality and quality of work so that it becomes a work culture. According to Sholihah & Kuncoro, (2014) A work success is rooted in the values they have and the behaviors that become their habits. These values originate from customs, religions, norms, and rules that become habits in work or organizational behavior. In working on a ship, there are procedures and regulations that must be obeyed by the crew in achieving the objectives of the ship's operational activities, however it is found that the crew has behavioral habits that come from their sailing experience, customs on board, the rules that become the confidence of the crew to behave that affects the performance of the crew.

A work culture found on board a ship contributes to the performance of the crew as stated by Arianto & Agung, (2013) there is an influence between work culture on performance.In addition, according to Adha & Achmad, (2019) work culture also has a positive effect on performance, According to Riduward et al, (2014) leadership style and work culture have a positive effect on performance.

In connection with the performance of the crew, communication skills are the interaction abilities possessed by individuals or someone on board to be able to interact and socialize with other individuals or people. With the existence of communication, this can facilitate the process of interaction between one another, in order to achieve the expected goal, namely the performance of the crew. Not to mention in the world of shipping, communication skills are very important where they are able to say messages well and effectively. Based on IMO SMCP (International Maritime Organization Standard Marine Communication Phrases), communication is divided into two, namely external communication and on-board communication.

Apart from the various things above, the more rapid development of the global trade economy, the ability to communicate on ships is needed. This is because various kinds of merchant ships and crews of any nationality are on board. The ships were manned by sailors from various nations, and who had to communicate with the ships around them in different languages.

Language is a communication tool to convey ideas, messages, and information embedded in the mind, the delivery medium can be through oral or written. Language also has a central role for the creation of shipping safety. In the IMO, the SMCP states that the standard language for seafarers is English. Skills in language, especially English on board, are also at risk of misunderstanding and resulting in ineffective tasks carried out. Mistakes like this cannot be tolerated when working on a ship, given the many dangers that threaten us. For that, everyone who works on the ship is also required to have language skills, especially English, in addition to having the ability to communicate. On the other hand, the role of a shipping company is very important in recruiting crew who will work on the ship, as regulated in the IMO SMCP about the knowledge of Standard Marine Communication Phrases so that there are no misunderstandings, so that sailing safety is created in daily tasks.

2. Research Objectives

The objectives in conducting this research were to determine the effect of work culture and communication skills on the performance of the crew, so that it becomes a reference for shipping companies, ship crew members and related parties.

3. Literature Review

This section will present various opinions or theories from experts or experts as well as previous research related to this research study. Theory and results from previous research will facilitate and guide researchers in completing the desired discussion. Various opinions or theories and previous research will be described in detail below.

4. Previous Researchers Previous

The previous researchers are useful to enrich the theory and reference sources in this study. Previous research that is relevant to this research regarding work culture, communication skills and crew performance will be described in full in this section. Arianto & Agung, (2013) there is an influence between work culture on performance, According to Adha & Achmad, (2019) work culture also has a positive effect on performance, According to Riduward et al, (2014) leadership style and work culture have a positive effect on performance. In research conducted by Arianto & Agung, (2013) as respondents were teachers with discipline variables, work environment, work culture on the performance of the teaching staff. Meanwhile, research conducted by Adha & Hafidz. 2019 who became respondents were employees of the Jember Regency social service, with variables of work motivation, work environment, work culture and performance. In a study conducted by Riduward et al (2014), the respondents were employees at the Regional Indonesian Broadcasting Commission (KPID) Secretariat Office of the Riau Islands province and the variables were leadership style, work culture and performance.

As for research related to communication skills, as has been done by Windyandari, A: 2011, that the development of communication systems for ships in Indonesia needs to be carried out considering the increasing number of ship accidents at sea and at the port. Someone who is skilled in English and has a good ability in communicating, especially with the crew, can support sailing safety when the ship is sailing. A good communication system on board needs to be improved as a supporting factor in shipping safety.

5. Work Culture

According to Triguno, (1995) work culture is a philosophy based on a view of life as values that become traits, habits, as a force that can encourage, culture in the life of a community group or an organization. According to Nawawi, (2005) work culture is a habit that is carried out by employees in an organization repeatedly, the habit does not have strict sanctions, according to him, this habit is a habit that should be adhered to in an effort to do a job to achieve a goal. According to Adha et al, (2019) work culture is a habit or behavior that is carried out during a routine repeatedly and if there is no strict sanction if it is broken.

These habits are used by someone to behave and behave which has dimensions to be used as a reference in behaving and behaving. Based on the work culture theory above, the writer defines the work culture on the ship as the attitude and behavior of the crew that is carried out repeatedly or routinely on the ship and if the crew violates, they do not get strict sanctions. According to Arianto, (2013) stated that in work culture there are indicators, namely the condition of the physical environment of work which is influenced by the provision of awards, welfare, the fulfillment of facilities and infrastructure. In addition, there are several factors that affect work culture such as support in carrying out tasks, the ability to design and design tasks, supervision and work discipline, communication or interaction with friends and leadership functions.

Work culture also has functions and benefits as expressed by Sholihah et al. (2014), in principle, work culture aims to build a belief in human resources or instill values that influence consistent attitudes and behavior and a commitment to getting used to a way of working in the environment. each. The function of work culture in general is a component of human quality inherent in the identity of the nation and becomes a benchmark in development. To participate in determining the integrity of the nation and become the main contributor to ensuring continuity in the life of the nation. It is closely related to the national values and philosophy that drive one's performance.

According to Robbins, quoted by Sholihah et al, (2014) the benefits of implementing a good work culture are increasing the spirit of mutual cooperation, increasing togetherness, being open to one another, increasing the spirit of kinship, building good communication, increasing work productivity and being responsive to world developments.

6. Communication Ability

Communication is a reciprocal process between the sender and the recipient which influences each other and contains information, messages, ideas, ideas, thoughts and feelings. Ability is the ability or potential of an individual to master expertise in performing or performing various tasks in a job or an assessment of someone's actions. Communication is a process of forming, conveying, receiving and processing messages that occur within a person and / or between two or more specific purposes, so that the purpose of communication, namely as control, means of channeling emotions and means of conveying information can be achieved.

In order for the communication process to run smoothly, several activities are needed to support it, namely: being a good listener, understanding the interlocutor, using body language well, speaking straight to the point, understanding the right time and place to talk, understanding the topic of conversation correctly, and ask for advice and input. From the above activities, it is hoped that the communication process will run smoothly so that the message to be conveyed can be received properly.

So, it can be interpreted that the ability to communicate on a ship is the ability or potential of an individual to master expertise in delivering messages or information about the mind which includes the ability to speak, write, draw and discuss on ships, between ships, ships and ports, ships and shipping companies and ships. with other related parties.

In communicating, there are aspects of communication skills that can support the communication process to run smoothly. There are six elements of the ability to communicate, namely: the source (source) / communicator of the party that will deliver the message, the message: the message to be conveyed, the receiver (the receiver): the party who will receive the message, barriers: barriers in communicating, response: a reaction to the message conveyed, the situation (situation): the situation when communication occurs.

Language skills can be obtained through continuous practice in using a language as a medium in communicating. This is in accordance with the opinion of Hoetomo MA (2005: 531-532) that skilled is proficient in completing tasks, capable and nimble. Skills are the skills to complete tasks. or the required skills. Language skills should be possessed by everyone to be able to communicate effectively.

In obtaining language skills, a person must have priority in learning a language so that he can be skilled in communicating. Richard (2008: 19, in Lindawati, Sengkey) states that mastery of English-speaking skills is a top priority for learners of second and foreign languages. The level of speaking skills is determined by the ability to express the contents of the mind according to the purpose and context of the conversation being carried out, how the contents of the mind are arranged so that it is clear and easily understood, and expressed in language that is packaged in a reasonable grammar arrangement, the right choice of words. , as well as pronunciation and intonation according to the purpose and nature of the speaking activity being carried out.

7. Performance of the crew

According to Edison (2016) performance is the result of a process that refers and is measured over a certain period of time based on predetermined terms or agreements. Meanwhile, performance is a reflection of their abilities and skills in certain jobs that will have an impact on the rewards of the company. Another opinion, performance or work performance is the result of work in quality and quantity achieved by an employee in carrying out his duties in accordance with the responsibilities assigned to him (Mangkunegara, 2006: 67). at the time and place of the employees and the organization concerned (Mangkuprawira and Hubeis, 2007: 153).

Performance is also the result of work achieved by a person in carrying out his duties on his skills, efforts and opportunities. Based on the above explanation, performance is a result achieved by a person in carrying out tasks based on skills, experience and seriousness and time according to predetermined standards and criteria (Hasibuan, 2002: 160). And another expert, Bernardin and Russel (in Ruky, 2002: 15), provide the following definition or performance: “performance is defined as the record of outcomes produced on a specified job function or activity during time period. Achievement or performance is a record of the results obtained from certain job functions or activities during a certain period of time.

Work motivation is one of the factors that can improve the performance of the crew. The performance of the crew is determined by motivation. In order for the crew to work in general, they must have motivation. A person will have work motivation if there is a condition that encourages or causes someone to do an action or activity, which takes place consciously. Likewise, on a ship, in fact there are still many jobs that are not completed according to the predetermined schedule so that it affects the crew's lack of motivation. This is due to the lack of morale of the crew on board the ship, which in turn will decrease work motivation.

The low work motivation possessed by the crew is due to the boredom experienced due to the past work contract period, as well as a lack of communication between the captain and other crew members. This problem needs to be addressed immediately, so that the performance of the crew can increase again so that ship operations can run smoothly as expected.

Quality and productive crew performance can be achieved if the crew is highly disciplined. Discipline is an aspect that has enough contribution to determine what things can be done in order to achieve certain goals. With continuous and continuous education and training, it usually shows the level of responsibility to carry out a job in accordance with ability, skill and knowledge (initiative). High discipline on a crew member will have a positive impact on performance, meaning that the more training a ship crew has to carry out a job, the more work can be completed and maintain the quality of his work.

There are factors that affect performance, namely effectiveness and efficiency where an activity is effective, but if the consequences are not sought, the activity assesses the importance of the results achieved so as to result in satisfaction even though it is effective it is called inefficient. On the other hand, if the effect sought is not important or trivial, then the activity is efficient (Prawirosentono 1999: 27). Authority (Authority), authority is the nature of a communication or order in a formal organization that is owned by a member of the organization to other members to carry out a work activity in accordance with their contribution. The order says what to do and what not to do in the organization. Discipline, is obeying the applicable laws and regulations. So employee discipline is the activity of the employee concerned in respecting the work agreement with the organization where he works. Initiative, related to thinking and creativity in forming ideas to plan something related to organizational goals.

The characteristics of employee performance according to the opinion of (Mangkunegara, 2002: 68) are having high personal responsibility, dare to take and bear the risks faced, have realistic goals, have a comprehensive work plan and strive to realize its goals, take advantage of feedback that is concrete in all work activities it does and looks for opportunities to realize the plans that have been programmed.

Meanwhile, the employee performance indicator is the quality as measured by employees' perceptions of the quality of workers produced and the perfection of duties on the skills and abilities of employees. Quantity, is the amount produced expressed in terms such as the number of units, the number of activity cycles completed. Timing accuracy, is the level of activity completed at the beginning of the time stated, seen from the point of coordination with the output results and maximizing the time available for other activities. Effectiveness, is the level of use of organizational resources (manpower, money, technology, raw materials) maximized with the intention of increasing the results of each unit in the use of resources. Independence, is the level of an employee who will later be able to carry out his work function. Work Commitment. It is a level where employees have a work commitment to the agency and employee responsibilities to the office.

8. Research Methodology

In this study, the method used is a quantitative research method where the answers obtained from the respondents and according to the predetermined variable values will then be analyzed using the SPSS computer program, Statistic21.0. Quantitative analysis was carried out to describe the relationship between variables in the study using statistical calculations, namely by linear regression analysis, test, F test and determination test. The statistical tests used to analyze the data were as follows.

a. Validity Test "Validity is how far the tool can measure the thing or subject you want to measure (Iqbal Hasan, 2004)". The correlation formula used to calculate the well-known validity is the product moment correlation formula, which is as follows:

$$r = \frac{n.\sum XY - (\sum X)(\sum Y)}{\sqrt{(n.\sum X2 - (\sum X)2)(n.\sum Y2 - (\sum Y)2)}} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Information:

r : Correlation coefficient
n : Number of samples
X : Independent variable
Y : The dependent variable

b. Reliability Test "Reliability means being trustworthy. A measuring instrument is said to have reliability if it is used many times by the same researcher or by other researchers it will still give the same results. So, reliability is how far the consistency of measuring instruments can provide the same results in measuring the same thing or subject (Iqbal Hasan, 2004) ". A questioner construction is said to be reliable if the value (α) is greater than 0.6.

9. Multiple Linear Regression

This analysis is used to analyze the effect of the independent variable (X), namely the ability to communicate (X1) and the use of international signal codes (X2) on the dependent variable (Y), namely the safety of ship shipping. The research model used in this study:

$Y = a + b1.\ X1 + b2.\ X2 + \mu$ …………………………. (2)

Information:

Y : Crew performance
a : Constants
b1, b2 : Multiple regression coefficients research factors
X1 : Work Culture
X2 : Communication Ability
μ : Other variables that are not detected

10. Hypothesis Testing

The hypothesis testing tools used are:

1. T-test (Partial Test)

This test is used to analyze the effect of each independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew. Testing criteria:

a. Ho: b = 0 This means that there is no positive and significant influence between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable Y, namely the performance of the crew.

Ha : b ≠ 0

This means that there is a positive and significant influence between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew.

b. Level of significant if α = 0.05 or 95%

c. If t count> t table

H0 is accepted: This means that individually there is a positive and significant influence between the independent variable (X), namely Work Culture (X1) and the use of code (X2) the ability to communicate on the dependent variable Y, namely the performance of the crew.

d. if t count <t table

Ho is accepted: it means that individually there is no positive and significant influence between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew.

2. F-test (Simultaneous Test)

This test is used to analyze the effect jointly or simultaneously between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew.

Testing criteria:

a. Ho: b = 0

This means that simultaneously there is no positive and significant influence between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew.

b. Ha: b ≠ 0

This means that simultaneously there is a positive and significant influence between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew.

c. The level of is significant if α = 0.05 = 95%

d. If F count> F table

Ha is accepted: This means that simultaneously there is a positive and significant influence between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew.

e. If F count <F table

This means that simultaneously there is no positive and significant influence between the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) on the dependent variable (Y), namely the performance of the crew.

f. The coefficient of determination (R2)

It is used to determine the contribution of the independent variable (X), namely Work Culture (X1) and the ability to communicate (X2) to the dependent variable (Y), namely the performance of the crew.

The formula used:

R2 = r2 X 100% …………………… (3)

Information:

R: Multiple correlation coefficient

r: Partial correlation coefficient

3. Research Variables

The variables in this study are described as follows:

a. *Independent Variable*

That is a variable that functions to influence other variables, so it independently affects other variables. In this study the independent variables are:

1. Work Culture (X1) The indicators in this study related to Work Culture are:
   a) Indicators of physical environmental conditions of work
   b) Indicators of environmental conditions of work sign jobs
2. The ability to communicate (X2). Indicators of communication skills are:
   a) Indicators of oral communication.
   b) Indicators of written communication.

b. *Dependent Variable*

Namely a variable whose function is influenced by other variables therefore it is also often called a variable that is influenced by other variables. In this study the dependent variable is the performance of the crew. Research indicators regarding crew performance factors are:

a. Ability of the crew
b. Motivation of the crew
c. Support received
d. Existence of ship crew work being carried out
e. Crew relationships with organizations

4. Population and Sample

According to Sugiyono (2012: 115) Population is a generalization area consisting of objects or subjects that have certain qualities and characteristics that are determined by researchers to be studied and then drawn conclusions. According to Sugiyono (2012: 116) the sample is part of the number and characteristics of the population, if it is large and the researcher is not possible to learn everything in the population, for example due to limited funds, energy and time, the researcher can use a sample from that population. sampling is a sampling technique. The population in this study are actually all commercial ship crews at the Surabaya North Quay pier, but due to limited funds, energy and time, the researchers took 98 samples. (ninety-eight) crew members of the ship in Surabaya North Quay.

5. Research Results

a. Validity Test Based on the results of calculations using the SPSS ver.21.0 tool, the value of Corrected item total correlation (r count) is obtained and the 12 (twelve) questions can be presented as follows:

Table 1: Validity test result

Research Variables	r count	r table	Conclusion
Work Culture			
Respondents Answer			
Question no.1	0,719	0,197	valid
Question no.2	0,791	0,197	valid
Question no.3	0,760	0,197	valid
Question no.4	0,325	0,197	valid
Ability to Communicate			
Respondents Answer			
Question no.5	0,513	0,197	valid
Question no.6	0,694	0,197	valid
Question no.7	0,748	0,197	valid
Question no.8	0,293	0,197	valid
Crew Performance			
Respondents Answer			
Question no.9	0,512	0,199	valid
Question no.10	0,684	0,199	valid
Question no.11	0,759	0,199	valid
Question no.12	0,544	0,199	valid

Source: Validity Test Results, 2021

Based on table 1, it can be seen that almost all of the respondents' answers have a value of r count> r table (0.199).

b. Reliability Test

By using the alpha formula, the reliability coefficient for each indicator is obtained which is summarized in table 2 below.

Table 2: Reliability test result

No	Variable	Alpha	Conclusion
1	Work Culture (X1)	0,783	Reliable
2	Ability to communicate (X2)	0,706	Reliable
3	Crew Performance (Y)	0,691	Reliable

Source: Reliability test result, 2021

From the results above, it can be explained that the variables in this study are reliable or reliable because they have an alpha coefficient that is greater than 0.60.

6. Multiple Linear Regression Analysis

The results of linear regression in this study can be shown in Table 3, the multiple regression line equation is obtained, namely:

Tabel 3: Summary of Calculation Result

Variable	Coefficient	t - ratio	Prog - sig	Conclusion
Constant	4,003	2,447	0,016	Significant
Work Culture	0,447	5,027	0,000	Significant
Ability to Communicate	0,296	2,087	0,006	Significant
F – count	35,78	(Prob - sig = 0,000)		
N	98			

Source: Summary of regression2021

Based on the summary above, the following equation is obtained:

$Y = 4.003 + 0.477\ X1 + 0.296X2 + m$

From this equation, it can be seen that work culture has a positive effect on crew performance by 0.477 units and communication skills have a positive effect on crew performance by 0.296 units.

7. Hypothesis Test

a) Hypothesis testing between Work Culture Variables on crew performance obtained t count> t table, namely 5.027> 1.993 means that Ho is rejected and Ha is accepted, namely there is a positive and significant influence between Work Culture on the performance of the crew.

Graphically the t test can be shown as follows:

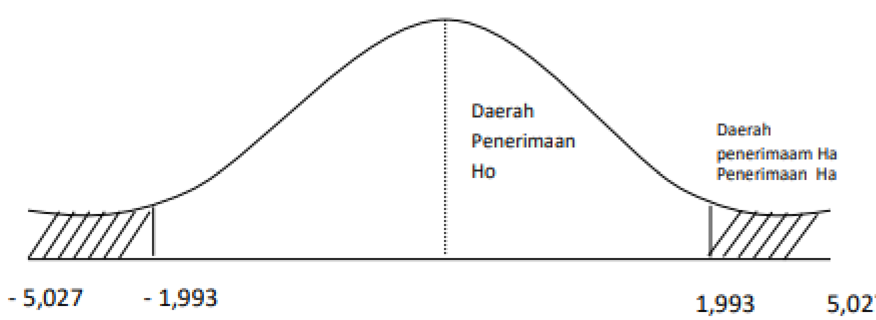

Figure 1 Graph of t test on variable X1

b) Hypothesis test between variables using international signal codes on shipping safety.

t count> t table 2,087> 1,993 means that Ho is rejected and Ha is accepted, that is, there is a positive and significant influence between the ability to communicate on the performance of the crew.

Graphically the t test can be shown as follows:

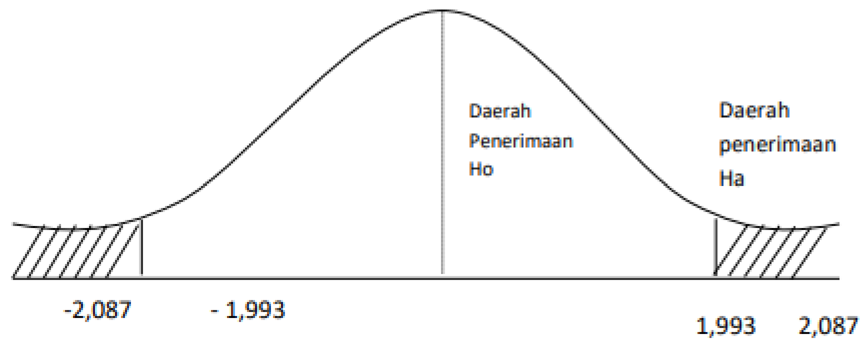

Figure 2 Graph of t test on variable X2

b. The F Test

The F test is used to analyze whether the independent variables (work culture, communication skills of the crew) simultaneously (together) have a significant effect on the dependent variable (crew performance). From the F test results obtained F count> F table, namely 35.478 > 1.37 this means that Ho is rejected and Ha is accepted, that is, there is a simultaneous influence on the independent variables of work culture and communication skills on the performance of the crew.

8. Determination Coefficient Test

The calculation results obtained the coefficient of determination (R2) of 0.442. This means that 44.2% of the variation in the performance of the crew is influenced by the work culture and communication skills of the crew. While the remaining 55.8% is explained by other variables outside the equation model.

9. Conclusion

a. From the linear equation it can be seen that work culture has a positive effect on crew performance by 0.477 units. From the t test, it is found that there is a significant influence between work culture on the ship on the performance of the crew as evidenced by t count> t table, namely 5.027> 1.993, therefore indicators of work culture are the physical environmental conditions of work and the environmental conditions of work sign jobs. must be improved so that the performance of the crew increases, because the working environment conditions will have implications for decreasing the performance level of the crew.

b. The ability to communicate using English has a positive effect on the performance of the crew by 0.296 units. The ability to communicate using English has a positive effect on the performance of the crew as evidenced by t count> t table 2.087> 1.993, therefore the indicators of the ability to communicate using English, namely communicators, messages and recipients must be improved so that the performance of the crew increases.

c. From the F test, it is found that together there is a significant influence between work culture and the ability to communicate using English on the performance of the crew. Likewise, the results of the determination test together, work culture factors and the ability to communicate using English have an effect on 44.2% of crew performance, therefore indicators in work culture and the ability to communicate using English have a significant effect on crew performance. ship.

10. Suggestions

1. For ship management to be more selective in recruitment related to work culture

and increase understanding, refreshing, updating for crew members about work culture so that the performance of the crew increases.

2. For maritime education institutions, it is better if they provide additional curriculum or training in maritime English, for shipping management it is better if they provide refreshing communication training, especially English for crew members who are already working and are selective in crew recruitment regarding the ability to communicate on board so that crew performance increases.

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THE ASSESSMENT OF JOB SATISFACTION AND EMPLOYEE PERFORMANCE TO THE COMPANY'S MOTIVATION AND LEADERSHIP STYLE

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Abstract

Previous research or relevant research is very important in research or scientific article where previous research or relevant research can serve to strengthen the theory and phenomenon of the relationship or influence between variables. This study aims to obtain an assessment of the relationship between job satisfaction and employee performance to the company's motivation and leadership style. This article reviews how the Determination of Job Satisfaction and Employee Performance on Motivation and Leadership Style in a Human Resource Management Literature Study. The results of this research library are that: 1) Motivation has a positive and significant effect on Job Satisfaction; 2) Leadership has a positive and significant effect on Job Satisfaction; 3) Motivation has a positive and significant effect on performance; 4) Leadership has a positive and significant effect on performance; and 5) Job Satisfaction has a positive and significant effect on performance. At the end of this research will produce a close conclusion about the relationship between job satisfaction and employee performance to the company's motivation and leadership style

Keyword: Job Satisfaction, Employee Performance, Motivation, Leadership Style.

1. INTRODUCTION

Employee performance is influenced by the level of job satisfaction they have, this was stated in previous research by (Amilin & Dewi, 2008), namely satisfied employees are influenced by the internal side, will involve their commitment to work, both professional commitment, and organizational commitment while from the external side, it is influenced by the environment in which they work, both from superiors, subordinates and at the same level. The commitment of organizational members is important in creating the survival of an organization. Luthans (2006) concluded that there is a cause-and-effect relationship between satisfaction and performance, where satisfaction affects performance more than performance affects satisfaction, there is a significant relationship between satisfaction and performance in the form of productivity, customer satisfaction, and even profit. In other words, employees who get satisfaction at work will have implications for work enthusiasm which in turn has an impact on employee performance.

This paper discusses the influence of Motivation and Leadership Style on Job Satisfaction and Employee Performance, (A Study of Human Resource Management Literature). Of course, not all factors affect Work Motivation and Employee Performance in this article, only a small part will be reviewed and reviewed. In detail, the purpose of writing this "Literature Review Paper" is to determine the influence or relationship between exogenous variables of Motivation and Leadership on endogenous variables of Job Satisfaction and Employee Performance.

a. The influence or relationship of motivation on job satisfaction
b. The influence or relationship of leadership style on job satisfaction
c. The influence or relationship of motivation on employee performance
d. The influence or relationship of leadership style on employee performance
e. The influence or relationship of job satisfaction on employee performance
f. The influence of motivation on

employee performance through job satisfaction

g. The influence of leadership style on employee performance through job satisfaction

2. MATERIALS AND METHODS

2.1. Job Satisfaction

Every individual in an organization has thoughts, feelings, and desires that can influence attitudes at work. These attitudes can be in the form of positive attitudes or negative attitudes, for example, job satisfaction, stress, and frustration arising from work, equipment, and the surrounding environment. (Abdurrahmat, 2006) stated that job satisfaction is a pleasant emotional attitude and loves his job. Indirectly, job satisfaction reflects a person's feelings about his job. However, according to (Judge, 2015) if someone does not get job satisfaction, this can be expressed through resignation, complaining easily, disobeying, stealing work equipment, and avoiding work responsibilities. It can be concluded that job satisfaction is a reflection of the attitude and behavior of employees in dealing with their work, which can be seen in enthusiasm in carrying out the job.

Riyanto et al (2017) suggest that job satisfaction is influenced by several factors, including psychological factors, social factors, physical factors, and financial factors. So it can be concluded that salary, job, promotion, and leader are some of the factors that can affect job satisfaction.

According to Hasibuan (2008), the indicators of job satisfaction are

1) working conditions,
2) promotion,
3) co-workers,
4) discipline and
5) work performance.

Luthans (2006) views that the dimensions of job satisfaction include:

(1) the work itself,
(2) salary,
(3) promotional opportunities,
(4) supervision, and
(5) co-workers.

So according to the opinion of the experts above, the indicators of job satisfaction are used in this study

(1) salary,
(2) colleagues,
(3) work performance,
(4) the work itself and
(5) promotional opportunities.

Two approaches are most widely used to measure job satisfaction (Judge, 2015), namely: The single global ranking method (a method that contains questions addressed to employees to respond to existing questions), through summation score (Calculation of aspects of job satisfaction with this approach is more sophisticated because it identifies certain job elements and asks employees how they feel about each of them). Meanwhile (Mangkunegara, 2011) suggests that measuring job satisfaction can be done by: Measuring job satisfaction with a job description index scale, measuring job satisfaction based on facial expressions, and measuring job satisfaction using the Minnesota questionnaire. So it can be concluded that the measurement of job satisfaction can be done by giving a series of questions to employees using five alternative answers (very satisfied, satisfied, neutral, dissatisfied, and very dissatisfied).

2.2. Employee Performance

Etymologically, performance comes from the word work performance (performance). How was stated by Mangkunegara (2011) that the term performance comes from the word work performance or actual performance (work performance or achievements achieved by someone), namely the quality and quantity of work achieved by an employee in carrying out his duties following the responsibilities assigned to him? Performance becomes two, namely individual performance and organizational performance. Individual performance is the result of employee work both in terms of quality and quantity based on predetermined work standards, while organizational performance is a combination of individual performance with group performance.

Meanwhile, according to Hasibuan (2008) performance is the work achieved by a person in carrying out a given task based on the ability and experience at work. Meanwhile, Byars and Rue in Sutrisno and Edy (2011) revealed that performance or work performance is the level of a person's ability and understanding of a given task which can be seen from the results of the work. Based on the above understanding, it can be concluded that performance is a comparison between the results achieved by the company and the sacrifices incurred by the company, including the resources used and the costs incurred by the company.

Veithzal Sagala (2013) argues that performance is a tangible behavior that is displayed by everyone as a work performance produced by employees following their role in the company. Thus, from this definition, it can be concluded that performance is the work performance or output, both quality, and quantity achieved by the unity of the period in carrying out its work tasks with the responsibilities assigned to it. Employee Performance Factors According to Timple in (Sularmi, 2018) six external factors affect employee performance, namely: environment, management behavior, job design, performance appraisal, feedback, and remuneration (wages/salaries). It can be concluded that the factors that affect employee performance include efficiency and effectiveness, including the use of appropriate working time, speed in carrying out work, level of absenteeism, maximum service, and penalties for making mistakes in carrying out work.

According to Siagian (2007), the factors that influence employees can become employees of two groups, namely: 1) Individual factors, namely age, temperament, individual physical condition, and motivation; 2) Factors that exist outside the individual, namely physical conditions such as sound, lighting, time, rest, length of work, wages, organizational form, social and family environment. Meanwhile, according to Haynes in (Sularmi, 2018), four ways must be done in measuring a person's performance or work, namely: determining the level of expected performance (analysis of job content, procedures to be performed, and behavior at work), monitoring progress (progress) by focusing on the results achieved, evaluating previous performance, providing feedback (suggestions) on one's performance. It can be concluded that measuring or assessing employee performance can be done by comparing the quantity and quality achieved, as well as evaluating the work done. The indicators used in measuring performance by each organization vary depending on the approach used by the organization. According to Wirawan (2009), performance indicators include:

1) quantity of work output,
2) the quality of the work, and
3) efficiency in carrying out tasks,
4) work discipline,
5) initiative,
6) accuracy,
7) leadership,
8) honesty, and
9) creativity.

2.3. Motivation

According to Dallu (2019), putting forward the basic motivational word is a motive that means because of the reason someone does something. That a human or someone is just doing an activity that is fun to do. This principle does not cover the condition that under certain circumstances a person may do something he does not like. Furthermore, Wibowo (2014) states that: *"Motivation is a judicial process of behavior on a record of objectives. While the elements contained in motivation include not generating, directing, maintaining, showing intensity, being continuous and having a purpose"*. Purwanto (2020) states that: *"Motivation is the driving force that causes a member of the organization to be willing and willing to mobilize skills and skills and the time to carry out various activities that are his responsibility and fulfill his obligations to achieve goals and various organizational suggestions that have been predetermined"*.

2.4. Maslow's Need Theory

According to Abraham Maslow, to decide one's actions or behavior is in the hierarchy of needs with 3 kinds of theoretical basic assumptions, namely: 1. Humans are creatures who always need something, namely the desire to satisfy various goals. Unmet needs will define behavior, but needs that are met will not motivate them to behave according to their needs. 2. A person's needs are arranged in order and or in order from the most basic to the highest. 3. A person's needs move from the lowest level to the next after the lowest level needs are maximally met. As a scientist who is seen as a pioneer of Abraham H. Maslow's theory of motivation. The results of his thoughts are contained in his book, entitled *"Motivation and Personality".* The motivation theory he developed in the 40s revolves around the opinion that humans have five levels or hierarchies of needs (Siagian, 1995):

1) Physiological needs, such as clothing, food, and shelter.
2) Security needs, not only in a physical sense but also mental, psychological, and intellectual.
3) Social needs.
4) The need for appreciation is generally reflected in various status symbols.
5) Self-actualization in the sense of providing opportunities for someone to develop their potential so that they turn into real abilities.

2.5. Maslow's Theory X and Mc Gregor's Theory

This theory was developed based on psychological research, with the initial concept that humans have extreme contradictory traits, for example in a person will behave gently, compassionately, sympathetic, obedient, and others. But at other times humans can also act harshly, hate, like to disturb, and so on. From the two sides of this characteristic, then it is developed into 2 theories, namely the theory of x and the theory of y.

Research conducted on "traditional" managers, it is found that traditional managers work based on a conceptual framework which is a negative extreme point, in other words, they use the theory x. Managers who use theory x see subordinates as having the following characteristics:

•, In general, they (people) do not like to work, therefore they should avoid work as much as possible.

• They (subordinates) do not like being directed
• They prefer to avoid responsibility
• They have no ambition
• They have a passive character. For all of this, the manager must take action in utilizing subordinates

by treating:

• They need to be forced to work by strict rules.

• They need orders and threats.

• They need to be closely monitored.

• And others that make subordinates submit and obey

2.6. Leadership Style

Definition of Leadership According to (Runa, 2020a) leadership is the process of influencing group activities organized towards the determination and achievement of goals. Meanwhile, according to Hendyat Sutopo in his book Organizational Behavior, leadership is a dynamic process, the leader-follower relationship is reciprocal in nature and develops through interpersonal transactions over time. However, the emphasis in our society is clear on the attributes or actions of leaders (Basyit, 2020)

Leadership is generally defined as the ability in one's readiness to be able to influence, encourage, invite, guide, mobilize, direct, and if necessary force people or groups to accept this influence and then create something that can help achieve certain goals that have been achieved. set

Leadership is part of management but not all of it. For example, managers need to plan and organize, but all that is asked of leaders is that they influence others to come along. Leadership is the ability to persuade others to achieve predetermined goals with enthusiasm. It is the human factor that binds a group and moves it towards the target, it is an action that makes all the potential contained in the organization and its people successful. (Runa, 2020b) Various leadership theories have been put forward, including George R. Terry in (Dewi et al., 2020) reveals six theories, including:

a. Situational Theory, in leadership there must be flexibility so that it can adapt to different situations. Leadership is multidimensional. leadership devices according to this theory consist of four variables: 1) The leader. 2) Followers. 3) Organization. 4) Social, economic and political influences. The so-called situation theory is because the leadership approach requires flexibility to the situation. His approach in this regard must be a lot of direct attention to economic and political developments

b. Personal Behavior Theory. One of the important contributions of this theory is that of a leader, where the actions of the leadership and the amount of authority used are related to the freedom to make decisions or participation by subordinates.

c. Supportive Theory. Here the leader wants to take the attitude that followers do their best and lead them.

d. Sociologic Theory. According to this theory, leadership focuses on two issues, namely efforts to launch activities and reconcile any conflicts between followers. The leader in this case determines the goal and the followers participate in its implementation.

e. Autocratic Theory. According to this theory, the leader acts with sanctions such as punishment if the order is not obeyed. On the other hand, he gives rewards when his work goes well. For example, by increasing wages by giving a bonus if production increases, on the contrary, cutting wages if the quality of goods is bad.

f. Psychological Theory. This approach to leadership states that the main function of a leader is to develop a good motivation system. Leaders stimulate their subordinates to help achieve the goals of the organizer and satisfy the goals. This approach to leadership states that the main function of a leader is to develop a good motivation system. The leader stimulates his subordinates to help achieve the goals of the organizer as well as to satisfy their own goals.

2.7. Research Methods

The method of writing scientific articles is by qualitative methods and literature study or Library Research. Reviewing literature books according to the theory discussed, especially in the scope of Human Resource Management (HRM). Besides that, it analyzes reputable scientific articles as well as scientific articles from journals that are not yet reputable. All cited scientific articles are sourced from Mendeley and Google scholars.

In qualitative research, the literature review should be used consistently with methodological assumptions. This means that it must be used inductively so that it does not lead to the questions posed by the researcher. One of the main reasons for conducting qualitative research is that it is explorative in nature (Ali & Limakrisna, 2013). Furthermore, it is discussed in depth in the section entitled "Related Literature" or a literature review ("Review of Literature"), as a basis for the formulation of hypotheses and will then become the basis for making comparisons with the results or findings revealed in the study. Ali & Limakrisna, 2013)

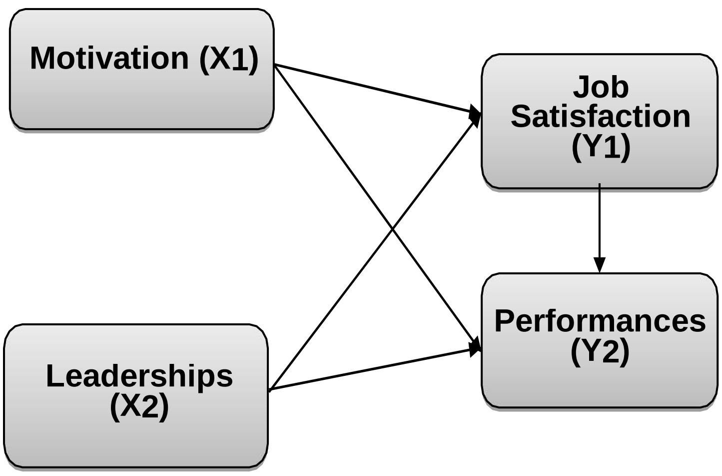

Figure 1. Conceptual Framework

3. RESULT AND DISCUSSION

3.1. Conceptual Framework

Based on the formulation of the problem of writing this article and a study of literature reviews from both relevant books and articles, the frame for this article is processed as below.

Motivation and Leadership Style has a relationship and influence on Job Satisfaction and Employee Performance, either directly or indirectly. Apart from the variables of Motivation and Leadership Style that affect Job Satisfaction and Employee Performance, many other variables influence it.

3.2. Influence / relationship between motivation and job satisfaction

Job satisfaction is a feeling of pleasure or displeasure with his job. These happy or unhappy feelings arise because when employees work they bring along their past wants, needs, and experiences that shape their job expectations. This work expectation is the motivation for the employees to work. The higher this work expectation can be fulfilled, the higher the level of employee job satisfaction. According to Badjuri (2009), job satisfaction cannot be separated by work motivation which is often an employee's job expectation. An accurate description of this relationship is that work motivation contributes to high job satisfaction. Job satisfaction will be high if the wants and needs of employees who become work motivated are met.

According to Alo (1997) argues that job satisfaction has a very large contribution to employee performance. Employee job satisfaction is obtained from supervisors who can provide motivation through humane actions and behavior and pay attention to cohesive human relationships among workers. Daft (2006) argues that motivation can lead to behaviors that reflect high performance in the organization. High employee motivation is closely related to performance and organizational requirements. Therefore, a manager must seek the right combination of techniques and motivational rewards to maintain worker satisfaction and productivity in a variety of organizational situations. Based on the description above, it can be seen that there is a clear relationship and influence between work motivation on job satisfaction and employee performance, where the benchmarks of an employee's performance can be seen whether or not the employee is working.

Job satisfaction is an important factor in improving employee performance. Employees are motivated to perform well but are not satisfied with their work. Some of the possible reasons are that employees need work and money. Money and jobs depend on a good performance, on the one hand, employees feel that they are entitled to a higher salary for the performance given to the company, but do not get it. According to (Mangkunegara, 2016) motivational factors have a significant influence on employee job satisfaction. This shows that the higher the motivational factors given, the higher the employee job satisfaction.

The high motivation that exists in employees is the capital for a company to be able to realize high job satisfaction as well, this is of course the hope that the company wants to achieve. Companies can choose how to motivate employees appropriately and following the situation and conditions of the company. According to (T. Hani. Handoko, 2014) the relationship of motivation to job satisfaction is that motivation in a person is a driving force that will manifest a behavior to achieve the goal of self-satisfaction.

Previous research on the effect of motivation on job satisfaction was stated by Agustina (2013) in her research that work motivation has a significant effect compared to other variables on job satisfaction. So that the management of the company must pay attention to work motivation factors. Because it has been proven that and motivation has a significant effect on employee job satisfaction.

3.3. The influence/relationship of Leadership Style on Job Satisfaction

Ruvendi (2005) in his research entitled "Rewards and Leadership Style Influence on Employee Job Satisfaction, at the Bogor Agricultural Products Industry Center", states that there is a positive relationship and significant influence between leadership style variables and job satisfaction of employees of the Bogor Agricultural Products Industry Center. . It was also revealed that an effective leadership style is a leadership that is tailored to the situation and conditions (contingency). Indications of a decrease in enthusiasm and enthusiasm for work are indicated by high levels of absenteeism and employee turnover. It arises as a result of unwelcome leadership. Research by Unud (2017) states that leadership style can influence an increase in job satisfaction towards a higher level. The positive and significant cause of the influence of leadership style on job satisfaction is because leaders always provide opportunities for employees to ask questions about work problems that are considered truly important so that it has an impact on the high job satisfaction of employees in completing work. Low work stress is not able to affect the increase in job satisfaction. This condition is caused because employees are very anxious in facing various job demands that trigger their performance and the company keeps laying off employees who cannot face the demands of their duties. The dominant leadership style affects job satisfaction. This condition is caused because the leadership always allows employees to ask questions about work problems that are considered truly important so that it has an impact on the high job satisfaction of employees.

Research on the relationship between leadership style and job satisfaction, namely Supartha (2006) Ethical leadership has a positive and significant effect on job satisfaction of employees at Asana Agung Putra Bali Hotel. This means that if the ethical leadership experienced by employees is getting better, the intensity of job satisfaction that occurs in Hotel Asana Agung Putra Bali employees will increase. Other research, namely Rahmi & Aziz (2017), Prasetiyo & Hakim (2020), there is a positive direct effect of leadership behavior on job satisfaction which means that an increase in leadership behavior affects increasing employee job satisfaction.

3.4. The Influence/relationship of motivation on employee performance

Simamora (2005) stated that compensation in the form of finance is very important for employees because with this compensation the physiological needs of employees will be achieved directly. However, an employee certainly has hope if the compensation he receives must be following the sacrifices that have been given to the company. Non-financial compensation is also important for an employee because it affects the employee's career development.

Wexley and Yukl (Liyas, 2017) define motivation as something that creates morale. Motivation is to offer the driving force that creates the excitement of a person's work so that they want to work effectively and are integrated with all their endeavors for satisfaction. Some of the opinions mentioned above represent an understanding from an internal perspective where motivation is seen as coming from within a person, as well as from an external perspective, which is seen as coming from outside oneself. Both types of motivation can affect the life of human behavior and individual behavior is essentially goal-oriented.

Research Putra et al (2019) which explains efforts to improve employee performance in achievement, recognition, expectations, and incentives, should first increase wages/salaries, working conditions, and rewards. The motivation that leads first to an increase in job satisfaction will directly be more effective in improving employee performance. Another study, Irawati et, al. (2019) shows that the motivation variable is related to employee performance, and is supported by other research, namely. I Wayan Arya Lantara (2018), Hermawati & Suganjar, (2020), Edwy, (2016), and Hidayat, (2019) show that work motivation has a positive and significant effect on employee performance.

3.5. The influence/relationship of Leadership Style on Employee Performance

The leader has the responsibility to create conditions that stimulate members to achieve the specified goals. The leadership style reflects a person's ability to influence individuals or groups. A leader must be able to maintain alignment between meeting individual needs and directing individuals to organizational goals. An effective leader is a leader who recognizes the important strengths contained in an individual or group and is flexible in the approach used to improve the performance of the entire organization.

According to Baihaqi (2010), leadership style in a company is important in a modern organization that requires democratization in the implementation of work and corporate leadership. Leadership style is the art of mobilizing all available resources to achieve goals with a strategy that is adapted to environmental conditions. The result that may arise from a bad leadership style is a decrease in employee performance which will have an impact on the decrease in the company's total performance.

Leadership style is a way for leaders to influence other people or their subordinates in such a way that the person is willing to do the will of the leader to achieve organizational goals even though personally this may not be liked. According to (Fisher et al., 2005) leadership has a strong positive effect on performance, it also has a significant effect on organizational learning. These findings indicate that the leadership style of a leader is very influential on the performance of his subordinates, in addition to getting a good performance it is also necessary to provide learning to his subordinates. Yusoff & Alhaji's research (2012) shows that leadership style has a positive and significant effect on employee performance. Leadership It does affect the performance of employees in the Office of the North Sulawesi Provincial KPU Secretariat. The type of leadership applied in institutions is manifested in the form of active participation of a leader in improving employee performance such as listening before he makes a decision, providing motivation to employees, conducting work evaluations that are tailored to their respective duties, and paying attention to employee career development is a type of leadership that is served.

Research results by Rohmah et al, (2018) show that leadership style has a significant effect on employee performance. The application of an autocratic leadership style causes employee performance to be controlled because activities in the organization are always under the supervision of the Village Head. The policies that are decided can be taken quickly because they are determined by the leadership and are important to be implemented for every employee. By striving for and creating harmonious relations between employees with the leadership and among colleagues, as well as more positive thinking will make the atmosphere at work more enjoyable so that it will improve performance within the organization. This is in line with the results of research (R. E. Nugroho, 2019; Pinatih & Gorda, 2017; Rochmanasari et al., 2013) that leadership style has a significant relationship and has a significant effect on employee performance.

3.6. The Effect/relationship of Job Satisfaction on Performance

Job satisfaction received and felt by an employee will affect the results obtained from his job. By obtaining job satisfaction by employees both by providing appropriate wages, jobs provided following their expertise, and relationships with superiors are well established, this will improve the performance of employees (Luthans, 2006). By obtaining employee job satisfaction, employee performance will increase because employees feel cared for by the company so there is an influence between employees and the company, namely, employees will fulfill job satisfaction and the company will get high performance from its employees.

This is following the opinion of Judge (2007) which states: "Performance is the level of efficiency and effectiveness as well as innovation in achieving goals by management and divisions within the organization. Performance is said to be good and successful if the desired goals can be achieved properly, performance is also seen as a function of the interaction between abilities, motivation, and opportunities so that one's performance is influenced by job satisfaction.

Suryosukmono's research (2020) explains that the desire to improve organizational performance makes managers start trying to accommodate the roles and functions of their subordinates. There is a demand for reform that was launched by the Bengkulu city government, although with the many challenges that have arisen, it is proven that it does not dampen the enthusiasm of the leaders to jointly invite their subordinates to boost the work performance of the City of Bengkulu. The positive habits initiated by the Heads of related Departments and Services, such as holding pre-work briefings, evaluation, counseling, mentoring, and providing religious motivation to civil servants are one of the real efforts that have proven positive in improving employee work performance. This is in line with research (Siagian, 1995), namely that there is a significant positive effect of job satisfaction on employee performance variables. It can be concluded that if job satisfaction increases, employee performance will increase. And vice versa if job satisfaction is low, employee performance will decrease.

Pre Research: Survey of the dominant factors affecting Job Performance (Y1) and Job Satisfaction (Y2).

Many factors influence Job Satisfaction (Y1) and Performance (Y2). Below is there 7 Factors or variables that influence job satisfaction (Y1) and performance (Y2) in the normal service companies in the banking, hospitality, insurance, and other service companies. The recapitulation of the praise results uses a Likert 5 scale, namely:

1. Not Influential
2. Less influence
3. Quite influential
4. Influential and
5. Very influential

Table 1. Pre-Research

No	Which Affects Y1, Y2	Value 1	Value 2
1	A1	53	8
2	B1	80	5
3	C1	76	6
4	**Leaderships (D)**	**89**	**3**
5	E1	71	7
6	F1	86	4
7	**Motivation G)**	**96**	**2**

The results of the pre-research show that the 2 dominant factors affecting Y1 and Y2 are as follows:

- Highest score 1 = Factor G, as Motivation (X1)
- Highest score 2 = Factor D, as Leadership (X2)

4. CONCLUSION AND FUTURE WORK

4.1. Conclusion

Based on the formulation of articles, results, and discussion, hypotheses can be formulated for further research:

1. Motivation affects Job Satisfaction
2. Leadership Style affects Job Satisfaction
3. Motivation affects employee performance
4. Leadership Style affects Employee Performance
5. Job Satisfaction affects Employee Performance

4.2. Future Work

Based on the conclusions above, the suggestion in this article is that there are still many other factors that affect Employee Satisfaction and Performance, apart from Motivation and Leadership Style at all types and levels of an organization or company, therefore further study is needed to look for other factors that can influence Job Satisfaction and Leadership Style other than those examined in this article.

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STRATEGIES TO INCREASE THE EFFECTIVENESS OF ABILITIES FASHARKAN MENTIGI OF TANJUNG UBAN TO SUPPORT THE STATE DEFENSE

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ABSTRACT

The maintenance and repair facility is one of the organizations within the Indonesian Navy that has the task of carrying out the maintenance and repair of KRI. In carrying out increasingly complex tasks, and the development of marine lift technology, maintenance and repair facilities require technological equipment and professional personnel in their fields. The purpose of this research is to determine alternative strategies to increase the effectiveness of the ability of Fasharkan Mentigi Tanjung Gray. This research uses the integration of SWOT analysis which is used to formulate and provide alternatives in the development strategy of the Mentigi Tanjung uban Fasharkan. Based on the results of the SWOT matrix analysis, in order to increase the effectiveness of the ability of the Tanjung Uban Mentigi Fasharkan to support the main duties of the Indonesian Navy, according to the SWOT method shows that the effectiveness strategy of fasharkan's ability lies in quadrant II with coordinates (0.38; 0.32) which indicates the SO strategy, namely the ability of the Mentigi Tanjung Uban Fasharkan to use optimal strength by taking advantage of existing opportunities, with alternative strategies The first is (1) the readiness of fasharkan to increase the effectiveness of the Mentigi Tanjung Uban Fasharkan capability which is supported by the Indonesian Navy policy and the Fasharkan operational strategy; and (2) the readiness of personnel supported by the development and training of personnel capabilities namely the ability of Fasharkan Mentigi Tanjung Uban to use optimal strength by taking advantage of existing opportunities, with the first alternative strategy being (1) Fasharkan readiness to increase the effectiveness of the Tanjung Uban Mentigi Fasharkan ability which is supported by the Indonesian Navy policy and Fasharkan's operational strategy; and (2) the readiness of personnel supported by the development and training of personnel capabilities namely the ability of Fasharkan Mentigi Tanjung Uban to use optimal strength by taking advantage of existing opportunities, with the first alternative strategy being (1) Fasharkan readiness to increase the effectiveness of the Tanjung Uban Mentigi Fasharkan ability which is supported by the Indonesian Navy policy and Fasharkan's operational strategy; and (2) the readiness of personnel supported by the development and training of personnel capabilities.

Keywords *: Fasharkan Mentigi Tanjung Pinang, SWOT.*

1. Introduction

Indonesia is an archipelagic country, where its geographic condition which is in a cross-country position places the national jurisdiction sea area very strategic both for Indonesia and for other countries. In addition to Indonesia's strategic geographic position, the Indonesian Navy's Center for Hydrography and Oceanography states that Indonesia has 17,504 islands, an area of 6.40 million km² of Indonesian waters, a territorial area of 0.29 million km², an area of 3.11 million km² of archipelagic waters, an area of the Economic Zone. Exclusive 3.00 million km², the land area of Indonesia is 1.90 million km², the area of Indonesia is 8.30 million km², the length of the Indonesian coastline is 108,000 km (Pushidrosal, 2018).

The implementation of the main duties of the Indonesian Navy in defending and maintaining sovereignty at sea can be carried out with support for infrastructure and mastery of Naval Technology, especially in the Integrated Fleet Weapon System (SSAT). SSAT readiness and mastery of oceanic technology greatly affect the implementation of the main duties of the Indonesian Navy in defending and safeguarding the sovereignty of the state, especially at sea. Thus the readiness of the SSAT, especially the Indonesian Warship (KRI), is a very priority to support security at sea. With the increasing number of the presence of KRI at sea, it will be able to control the sea area and be able to minimize risks and be free from all threats that have so far existed so that the stability and balance and security of the sea are maintained.

To be able to carry out their duties optimally, warships in the ranks of the Indonesian Navy must be ready to operate. To maintain operational readiness, ships as one of the main components of SSAT, the Indonesian Navy currently has three fleets, namely Fleet I, II and III, in which there is a unit that is responsible for providing maintenance and repair facilities. In this case the Fleet I area has several Fasharkan scattered in several Lantamals according to Figure 1.1

Figure 1.1 Distribution Map of Fasharkan in the Working Area of Koarmada I

The geographical location of the Lantamal IV working area is very strategic, because there are the Malacca Strait and the Singapore Strait which are sea lines of trade (SLOT), sea lines of communication (SLOC), and chokepoint for international shipping. The position of Lantamal IV is very strategic to be used as a stopover for KRI which will carry out border operations and the Operations Task Force Abroad. For this reason, it is very important to have adequate facilities and facilities for the maintenance and repair of ships. In this case, the TNI AL Battleship Maintenance and Repair Facility (Fasharkan) is a unit that functions to facilitate the maintenance and repair of Indonesian warships. Fasharkan Lantamal IV, Mentigi Tanjung Uban, as part of the TNI AL's main base organization, has the main task of providing services in terms of maintenance and repairs to support the operations of the Indonesian Navy's defense equipment. In every implementation of operational activities involving neighboring countries in the western region.

The determination of goals and strategies is a process that ultimately requires an agreement between stakeholders and leaders in determining them, as an analysis tool in this study using a SWOT (Strengths Weaknesses Opportunities and Threat) analysis. With the SWOT analysis, several strategic formulations will be obtained, so that the appropriate strategy stages can be obtained for the development of the Tanjung Uban Mentigi.

Faced with the current condition of Fasharkan Lantamal IV Mentigi Tanjung Uban, with limited human resources, facilities and equipment for workshop support, in providing maintenance and repair support for Indonesian Navy ships in Mentigi Fasharkan, it can be felt that its performance is still ineffective because it is not yet optimal facilities for docking, Besides that the workshop facilities, safety equipment and supporting transportation equipment are old and still manual so they are still behind with current technology.

2. Material and methods

2.1 Development Strategy

Management strategy is a managerial action in making decisions in determining the direction of performance in the long term of an organization which includes observations of environmental influences, formulation or planning of a strategy, implementation of evaluation and implementation of the strategy itself (J. David Hunger, 2003). If seen from the etymology, strategy from Greek which is taken from a derivative of the word strategos, in the Athenian era of democracy which means "military commander". However, from the perspective of the terminology, experts have different understandings of the meaning of strategy, but basically have a similar meaning, namely a plan to achieve goals efficiently and effectively (Syahtaria, 2019).

Management strategy can be defined as the art and science of formulating, implementing, and evaluating cross-functional decisions that enable an organization to achieve its goals. This definition implies that strategic management focuses on integrating management, marketing, finance/ accounting, production / operations, scriptwriting and development, and information systems to achieve organizational success. The term strategic management in this text is used synonymously with the term strategic planning (Istiqomah, 2017)

2.2 SWOT Analysis Concept

SWOT analysis is the most common technique that can be used to analyze strategic cases (Hill, 1997). SWOT is a tool that is often used to analyze the internal and external environment to achieve a systematic approach and support for decision situations (Wheelen, 2012). SWOT is an acronym for strength (S), weakness (W), opportunity (O) and threat (T). The first two factors (strengths and weaknesses) are related to internal organizational factors, while opportunities and threats cover the broader context or environment in which the entity operates (Collins-Kreiner, 2007).

Matrix SWOT can clearly describe how the external opportunities and threats faced by the company can be adjusted according to its strengths and weaknesses. The SWOT matrix is a matching tool that develops four types of strategies, namely SO, WO, ST and WT (J. David Hunger, 2003). Good business planning using the SWOT method is summarized in the SWOT matrix as follows:

Table 2.1 SWOT analysis matrix

IFAS / EFAS	Strength	Wea*kness*
Opportunity	STRATEGI (SO) Create a strategy that uses your strengths to take advantage of opportunities	STRATEGI (WO) Create strategies that minimize weaknesses to take advantage of opportunities
Threats	STRATEGI (ST) Create a strategy that uses strength to overcome threats	STRATEGI (WT) Create a strategy that minimizes weaknesses and avoids threats

Source: Philip Kotler, 2002 in Khoiroh, 2016

2.3 Data source.

Primary data can be collected in a number of ways. However, the most common techniques are self-administered surveys, interviews, field observations, and experiments. Secondary data is data that is collected by other people for other primary purposes. Utilization of existing data provides the right choice for researchers who have limited time and resources.

2.4 Research Subjects.

Research subjects are agencies or organizations that are directly involved in the research. Research resource persons are people who understand about Mentigi's Fasharkan. The resource persons used in this research were those who were directly involved in the research, namely: Kafasharkan Mentigi, Kabagren Fasharkan Mentigi, Kabagprod / Fasharkan Mentigi Staff, Kabengdock, Kabengbakap / Mentigi Fasharkan Staff, KKM KRI in first Fleet.

2.5 Research Object.

Object research is everything that is at the core of the formulation of the problem in research. The object of this research is Fasharkan Mentigi Tanjung Uban. The research object is directed to help formulate a development strategy with the criteria of Organization, Human Resources (HR), infrastructure and technology.

2.6 Data collection techniques.

Data collection is carried out to obtain the information needed in order to achieve the research objectives. In this study, data collection techniques were carried out through observation, interviews and documentation / literature study. Primary data through observation and interviews (in-depth interviews) are data collected and processed by the researcher from the subject or object of the study. Meanwhile, secondary data through documentation / literature study is data obtained indirectly from the subject or object of research.

2.7 Research Flow diagram.

The big report regarding all research activities is depicted in a flowchart as in Figure 2.1

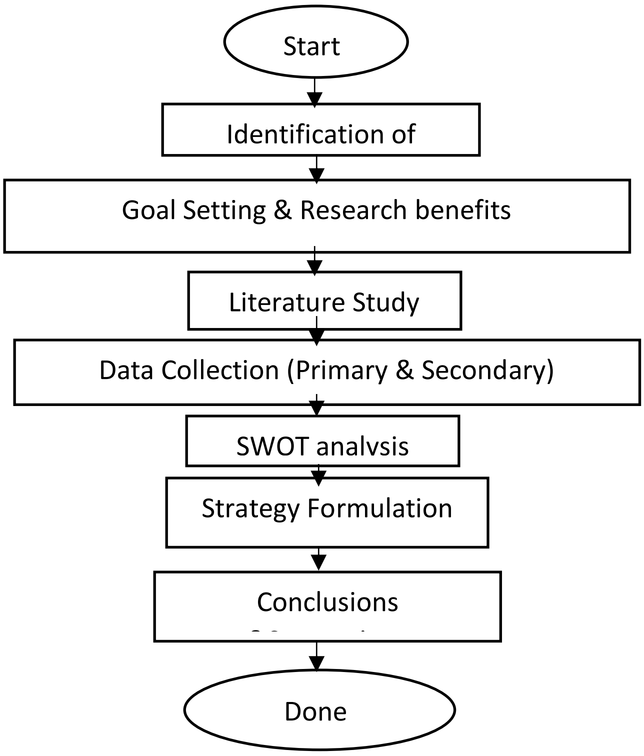

Figure 2.1 Research Flowchart

3. Result and discussion

The data that has been obtained from interviews and questionnaires are used for processing with the IFAS and EFAS Matrix. The data that has been obtained are processed to obtain a strategy to improve the ability of Fasharkan Mentigi Tanjung uban using the SWOT Matrix.

3.1 Analysis Identification of Ability Internal Factors Mentigi Tanjung Uban's Fasharkan

Internal factor of Fasharkan Mentigi Tanjung Uban is an activity in the management environment of developing a strategy in increasing the effectiveness of the ability of Fasharkan Mentigi Tanjung Uban, which consists of the strengths and weaknesses of Fasharkan. The aspects used to identify the internal strengths and weaknesses of the capability Mentigi Tanjung Uban Fasharkan.

Table 3.1 IFAS Calculation Matrix

No.	Internal Factor	Weight	Rating	Score
Strength (S)				
1	Fasharkan readiness	0.06	3	0.17
2	Maritime society	0.06	3	0.17
3	Facilities and infrastructure fasharkan	0.06	4	0.23
4	Personnel readiness	0.06	4	0.23
5	Biological resources	0.05	3	0.16
6	Indonesian Navy airforce	0.05	3	0.16
7	Spotmar TNI AL	0.06	4	0.22
8	The existence of fasharkan	0.06	3	0.17
9	Power Support fasharkan	0.06	4	0.22
10	Improved personnel quality	0.06	2	0.11
	Total Strength Score (S)	**0.55**	-	**1.82**
Weakness (W)				
1	The number of defense equipment	0.05	3	0.16
2	Operational volume	0.04	3	0.12
3	A large fleet	0.04	3	0.12
4	The number of Indonesian Navy	0.05	4	0.21
5	Electronic observation tools	0.05	3	0.15
6	Military readiness	0.06	3	0.17
7	Lots of military means	0.04	3	0.12
8	The number of working areas	0.04	3	0.12
9	There is no development fasharkan	0.05	4	0.18
10	Limit of fasharkan personnel	0.04	3	0.12
	Total Weakness Score (W)	**0.45**	-	**1.45**
Total Score IFAS		**1.00**	-	**0.38**

The results of identification, data tabulation and weighting score calculations according to the expert's answers to the questionnaire on the Internal Fasharkan Factors in the form of strengths and weaknesses that have been given weight and rating (Table 3.1), have obtained a score on the IFAS matrix of 0.38. With details, the score on strength was 1.82 and the score on weakness was 1.45. The IFAS value shows that currently the ability of the Mentigi Tanjung Uban Fasharkan is in a strong position, which means that currently the effectiveness of the ability of fasharkan has a strong internal condition in utilizing strengths and overcoming weaknesses that have an influence on the effectiveness of the existing capabilities of the Mentigi Tanjung Uban Fasharkan.

Tabe3.1 shows that the IFAS matrix has the main strengths of the Mentigi Tanjung Uban fasharkan, namely: "Facilities and infrastructure fasharkan" and "Personnel Readiness" with the highest score of 0.23. then the second strength, namely: "Sportmar TNI AL" and "Fasharkan Supporting Capacity" with the second highest score of 0.22. Then in third place, namely: "Fasharkan Readiness", "Maritime Society" and "Existence Fasharkan" with the third highest score with 0.17.

The main weakness face by Fasharkan were related to the effectiveness of the Mentigi Tanjung Uban's Fasharkan capabilities, namely: "Many fleets" with the highest score of 0.21. And the second weakness that must be faced by Fasharkan is: "There is no development of fasharkan" with a score of 0.18. Then the third weakness that must be faced by Fasharkan is: "Military readiness" with a score of 0.18.

3.2 Analysis Identification of External Factors Ability of the Mentigi Tanjung Uban Fasharkan

External factor of Fasharkan Mentigi Tanjung Uban is an activity in the external environment of management strategy development in increasing the effectiveness of the Mentigi Tanjung UbanFasharkan, which consists of opportunities and threats that are owned by Fasharkan.

Tabel 3.2 EFAS Calculation Matrix

No.	External factor	Weight	Rating	Score
Opportunity (O)				
1	Maritime community empowerment	0.08	4	0.31
2	Indonesian Navy Policy	0.08	3	0.25
3	Fasharkan Operations Strategy	0.06	3	0.19
4	Personnel Development	0.06	3	0.19
5	Infrastructure Empowerment	0.07	3	0.21
6	Maritime Potential	0.08	3	0.25
7	Personnel Abilities	0.06	3	0.19
8	Personnel exercise	0.06	3	0.18
	Total Score Chance (O)	**0.56**	**-**	**1.77**
Threat (T)				
1	The number of defense equipment that must be handled is a lot	0.04	3	0.12
2	The hours of operation for Alutsista are solid	0.05	4	0.19
3	Geographical Work Area of Fasharkan	0.06	3	0.19
4	Wheather in the Fasharkan Work Area	0.05	4	0.19
5	Largest the Fasharkan Work Area	0.05	4	0.19
6	Fasharkan Work Range	0.06	3	0.19
7	Largest the Work Area of the Indonesian Navy	0.06	3	0.19
8	Fasharkan Personnel Empowerment	0.06	3	0.18
	Total Threat Score (O)	**0.44**	**-**	**1.45**
	Total EFE	**1.00**	**-**	**0.32**

The results of identification, tabulation of data and calculation of weighting scores according to expert answers to the questionnaire on External Factors of Fasharkan in the form of opportunities and threats that have been given weight and rating (Table 3.2), have obtained a score on the EFAS matrix of 0.32, with a breakdown of the score on opportunity of 1.77 and the score on Threat is 1.45.

The EFAS value shows that currently the ability of the Mentigi Tanjung Uban Faculty of Law is in a strong position which means that currently the effectiveness of the fasharkan has a strong external condition in taking advantage of opportunities and controlling the existing threats of the Tanjung Uban Mentigi Fasharkan.

Table 3.2 shows that the EFAS matrix has a major opportunity factor (O) which is measured from the aspect of the Mentigi Tanjung Uban Fasharkan, which consists of: "Empowerment of maritime communities" with the highest score of 0.31. Then the opportunity (O) the ability of Fasharkan Mentigi Tanjung Uban rank second is measured from: "Indonesian Navy Policy" and "Maritime Potential" with a score of 0.25. And then the third rank of opportunity (O), measured by the ability of the Mentigi Tanjung Uban Fasharkan, namely "Infrastructure Empowerment" with a score of 0.21.

And The main threat faced by Fasharkan lies in the ability of Fasharkan Mentigi Tanjung Uban, namely: "The Many Duties of Alutsista", "Geographical Location of Fasharkan Work Areas", "Weather in Fasharkan Work Areas", "Extent of Fasharkan Work Areas", "Fasharkan Work Range" and "The extent of the Navy's Work Area" with the highest score of 0.19. And the second rank threat that must be faced by the Mentigi Tanjung Uban Fasharkan, namely: "Empowering Fasharkan Personnel" with a score of 0.18. Furthermore, the third rank threat that must be faced by Fasharkan Mentigi Tanjung Uban, namely: "The number of Alutsista that must be handled" with a score of 0.12.

3.3 Internal - External Matrix Analysis

Internal-external matrix analysis (IE) is obtained from the total weighted score of the IFAS and EFAS matrix, then the resulting weighted score is entered into the IE matrix to map the current position of the company, which can be seen in the IE matrix table.

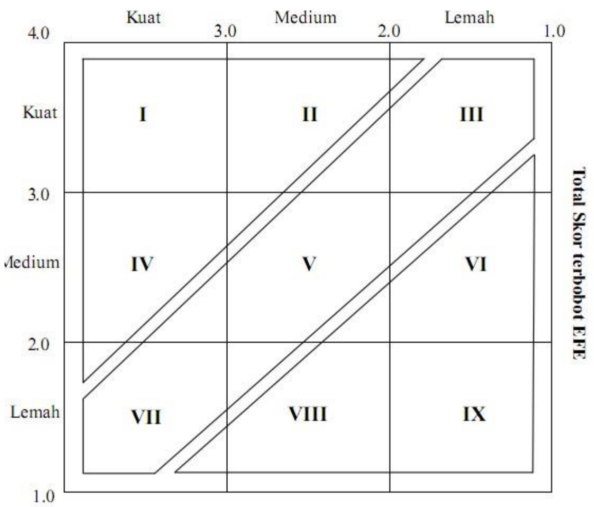

Figure 3.1 Internal - External Matrix

Based on Table 3.1, Table 3.2 and Figure 3.1, it is known that the IFAS value is 0.38 and the EFAS is 0.32. This means that the position of the Mentigi Tanjung Uban Fasharkan Ability strategy in Cell I is: Growth and Build.

3.4 Strategy formulation

SWOT Matrix are used to formulate strategies based on a combination of internal and external environmental analysis. There are four main strategies used, namely;

a. SO strategy : a strategy that uses strength to take advantage of opportunities.

b. ST strategy : a strategy that uses strength to overcome threats.

c. WO strategies : strategies that minimize weaknesses by taking advantage of opportunities.

d. WT strategy : strategies that minimize weaknesses, and at the same time anticipate threats.

Table 3.3 shows that the SWOT matrix (Strenghts, Weakness, Oppurtinity and Threats) arranged systematically and structurally can form four matrix strategies, namely: SO, ST, WO and WT strategies.

Table 3.3 SWOT Matrix

	Strength	**Weakness (W)**
	1. Fasharkan	1. Availability of defense
	2. Maritime society	2. Operational volume
	3 facilities and	3. Fleet in operation
	4. Personnel readiness	4. The number of Indonesian Navy personnel
	5. Biological resources	5.Electro nic observat ion tools
	6. Indonesian	6. Military readiness
	7. Spotmar TNI AL	7. Lots of military means
	8. The existence of fasharkan	8. The number of working areas
	9. Carrying capacity fasharkan	9. Absence developmentn fasharkan
	10. Improved personnel	10. Limited personnel fashaguess

Opportunity (O)	**SO**	**WO strategy**
1. Empowerment masyara kat maritime	1. Fasharkan readiness for increase the effectivene ss of the Mentigi Tanjung Uban Fasharkan capability which is supported by the Indonesian Navy policy and the	1. The availability of defense equipment, volume more operational and fleet to take advantage of personnel and infrastructure development. (W1, W2, O4, O5)
2. TNI policy AL		
3. Operations Strategy Fasharkan		
4. Coaching Personnel		
5. Empowerment Infrastructure		
7. Ability Personnel	2. Personnel readiness supported with the coaching and training of	2. Military readiness with take advantage fasharkan operative strategy (W6, O3)
8. Personnel Training		
Threats (T)	**ST strategy**	**WT strategy**
1. Number of Alutsista that is handled	1. Readiness for use fork to overcome the number of defense equipmen t handled with tight	1. Milliter readiness for meminimized to overcome the work range of fasharkan (W6, T5)
2. Hours of operation Solid defense equipment		
3. Geographical location Work		
4. Weather on Work area Fasharkan	2. The existence of fasharkan for to handlei geographic location, weather, coverage and area of the work area of fasharkan	2. Lots of military means overcome geographic location, weather, range and extent of work areas of fasharkan and TNI AL (W7, T4, T5, T6)
5. The breadth Area Work Fasharkan		
6. Reach Fasharkan Work		
7. The breadth area work of the Navy	3. Improve the quality	3. The absence of fasharkan development is

8. Empowerment Personnel Fasharkan	of personnel overcome the empowerm	handled through empowering fasharkan personnel (S9, T8)

Based on Table 3.4 shows the IFAS and EFAS results then presented in a SWOT quadrant chart or Cartesian diagram. A point on the X-axis indicates the internal factor (IFAS) while the point on the Y-axis shows the value of the external factor. Then drawn a meeting line between the two. This graph shows the current position or position of the Mentigi Tanjung Uban's Fasharkan, can be seen in Figure 3.2, as follows:

Figure 3.2 Position of the Mentigi Tanjung Uban Fasharkan Capability Strategy

Based on Figure 3.2 shows that the quadrant of the IFAS and EFAS calculation results is the S quadrant (the Strength and Oppurtunity quadrant). The value obtained from the IFAS is (0.38) which is located on the SWOT quadrant axis. The value of EFAS is (0.32) which lies on the ordinate axis of the SWOT quadrant. The position of mentigi tanjung uban's Fasharkan Lantamal IV ability is located in quadrant II with coordinates (0.38; 0.32) which indicates the SO strategy, namely the ability of Tanjung Uban's Mentigi Fasharkan ability to use optimal strength by taking advantage of existing opportunities. Things that can be done by the ability of the Mentigi Tanjung Uban Fasharkan are by:

a. Readiness of fasharkan to increase the effectiveness of the Mentigi Tanjung Uban Fasharkan capability which is supported by the Indonesian Navy policy and the Fasharkan operational strategy.

b. Readiness of personnel supported by coaching and training of personnel capabilities.

4. Conclusion

The conclusions that can be drawn from the results of the analysis and discussion are as follows :

a. Based on the results of the IFAS - EFAS score, the results of the identification of the effectiveness of the Mentigi Tanjung Uban Fasharkan ability are based on the results of the IFAS - EFAS score, an IFAS score of 0.38 and an EFAS score of 0.32, so internal and external factors that support the effectiveness of the ability of the Tanjung Uban Mentigi Fasharkan in supporting the main task of the Indonesian Navy are the strategy of utilizing strength. and Opportunities.

b. The strategy formula in order to increase the effectiveness of the ability of Fasharkan Mentigi Tanjung Uban in supporting the main tasks of the Indonesian Navy, according to the SWOT method, it shows that the effectiveness strategy for the ability of fasharkan is located in quadrant II position with coordinates (0.38; 0.32) which indicates the SO strategy. Fasharkan Mentigi Tanjung Uban uses optimal strength by taking advantage of existing opportunities, with the first alternative strategies are (1) the readiness of fasharkan to increase the effectiveness of the capabilities of the Tanjung Uban Mentigi Fasharkan supported by the Indonesian Navy policy and the Fasharkan operational strategy; and (2) the readiness of personnel supported by the development and training of personnel capabilities

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TIMING AND THE AMPHIBIOUS LANDING PLACE IN THE WATERS OF TUBAN BEACH BASED ON ASPECTS OF METEO – OCEANOGRAPHY

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ABSTRACT

Amphibious operation integrates various types of force that ships, aircraft, and landing troops in an attack on enemy beaches and or potentially controlled by the enemy and marine nature in the sense that the Navy took the lead role as reflected in the way the implementation of such operations. Wind and rainfall information, wave, depth, tide, and currents as well as the characteristics of known absolute Tuban beach. Plot Wr analysis method Tuban beach waters wind, waves and currents follow the pattern of monsoon circulation, while the harmonic analysis is known that the type of tidal waters Tuban beach entrance in a single daily group. Basic morphology Tuban coastal waters are generally very gentle slopes to a depth of 30 m and partly sandy, muddy, and quicksand coastal waters. Wind speed max of 14.87 knots. The rainfall max of 56 mm/hr. The significant wave height of 0.6 m and a wave period of 4.6 s.The High Waters Level of 180 cm and Low Waters Level of 40 cm and Mean Sea Level of 140 cm. The max speed of 76.47 cm/s.

Keywords*: Amphibious Operations, Meteo-Oceanographic aspects, Wr plot analysis method and harmonic analysis, bathymetry.*

1. INTRODUCTION

Tuban coastal waters are one example of some areas that will be used as landing sites. Historically Tuban is the main port city on the rich north coast of Java and has many Chinese residents. The Chinese call Tuban by the name Duban or another name is Chemin. Chinese-Mongolian troops (Tartar army), which in 1292 came to attack eastern Java (the event that caused the founding of the Majapahit empire) to land on the coast of Tuban (BPS Tuban, 2012). The landing beach is part of the landing line which can be used for landing troops and their elements or part of the landing site chosen for landing operations. Often referred to as a colored beach or numbered beach. Determination of landing beaches is part of the basic decision on Amphibian operation planning (PUM AL 1.01-1.31). The purpose of this research is to be able to determine the right choice of time and place of landing based on aspects of Meteo-Oceanography in Tuban coastal waters.

2. RESEARCH METHODS

This research was conducted in an area of the Tuban coast along Demari, Sugih Waras, and Tg. Awar-awar, Demari Beach is located at Coordinate 06 ° 53'47.32 "S - 112 ° 04'57.36" T, Sugih Waras Beach at Coordinate 6 ° 51'55.62 "S - 112 ° 01'55.54" T And the Awar-Awar Capes at Coordinate 6 ° 45'46.42 "S - 111 ° 57'50.42" T. Whereas the Tidal Station at Coordinates 06 ° 47 '24.66 "S - 111 ° 59 '11.37" T, Meteo Station at Coordinates 06 ° 86'35.67 "S - 112 ° 03'04.00" T

2.1. Geographical Location

Tuban Regency East Java Province is an area located on the northern coastline (Pantura) of the island of Java, located at coordinates 111 ° 30 'to 112 ° 35' East Longitude and 6 ° 40 'to 7 ° 18' South Latitude boundaries region north of the Java Sea, east of Lamongan Regency, south of Bojonegoro

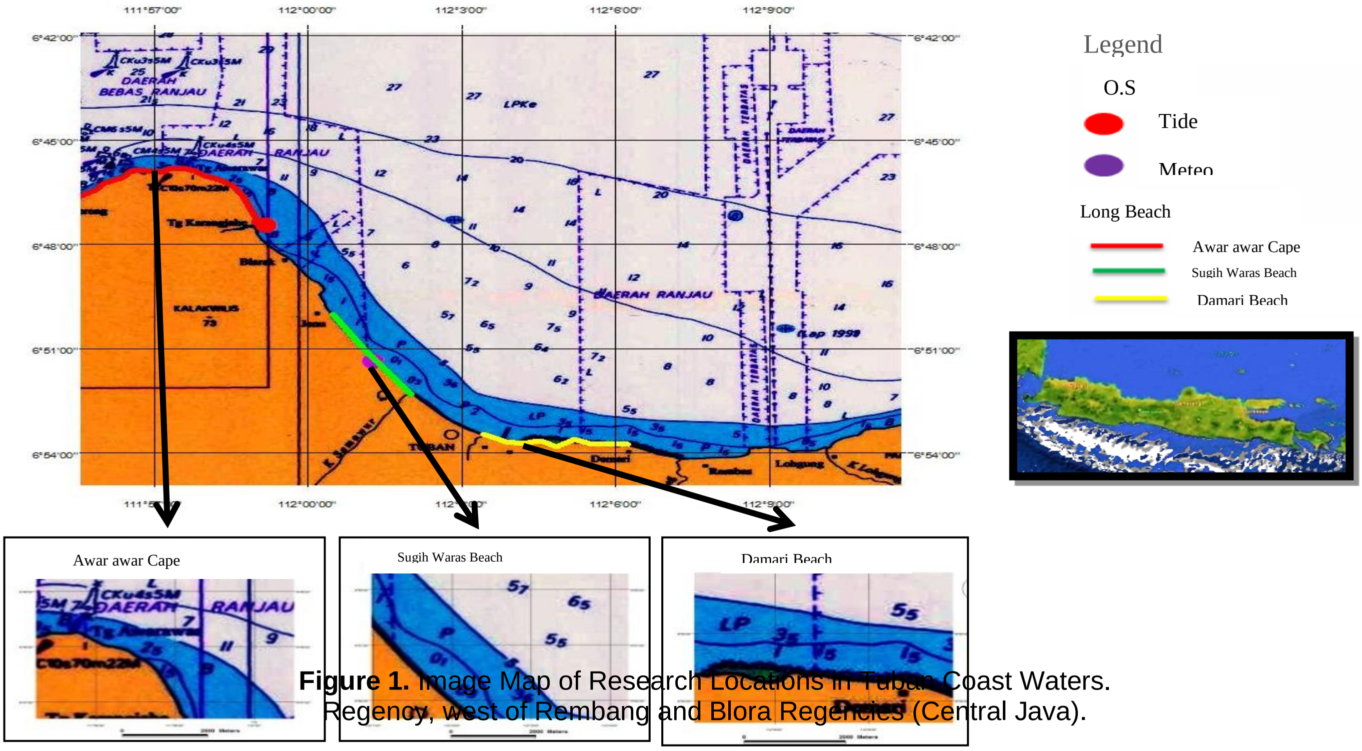


Figure 1. Image Map of Research Locations in Tuban Coast Waters. Regency, west of Rembang and Blora Regencies (Central Java).

2.2. Geology

Geologically, Tuban Regency is included in the northern part of the East Java basin which extends westward and eastward from Semarang to Surabaya. Most of the Tuban Regency is included in the Rembang Zone which is dominated by sediment which is generally in the form of carbonate rocks. The Rembang Zone is dominated by limestone hills.

2.3. Topography

The height of the land in the Tuban Regency ranges from 5-182 meters above sea level (asl). The northern part of the lowlands with an altitude of 0-15 meters above sea level, the southern and middle is also a lowland with an altitude of 5-500 meters. Areas with elevations of 0-25 m are located around the coast and with Bengawan Solo, while areas with elevations above 100 meters are located in Montong District. The area of agricultural land in the Tuban Regency is 183,994,562 Ha consisting of 54,860,530 Ha of paddy fields and 129,134,031 Ha of dry land.

2.4. Climate

Tuban Regency is a dry climate area with a somewhat dry to very dry variation covering an area of 174,298.06 Ha (94.73%) of the Tuban area, while the rest is approximately 9,696.51 Ha (5.27%) is an area that is quite wet. (BPS Tuban, 2012)

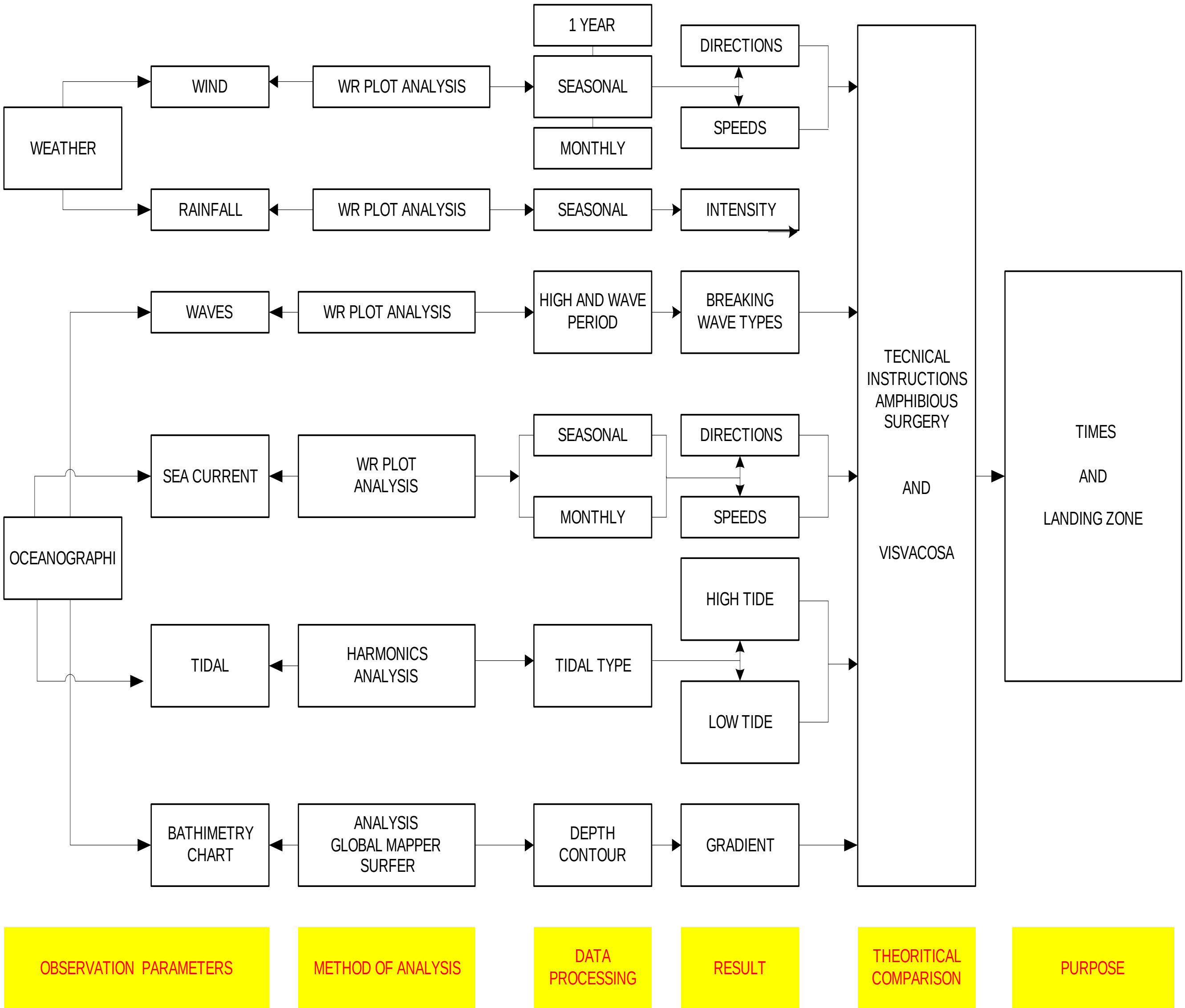
2.5. Tools and materials

The tools used in this study consisted of hardware and software. Hardware includes 1 unit of

Laptop, printer. The software used includes WR Plot Application Software, Global Mapper, Arcview 3.3, Surfer 10, Microsoft Office, Microsoft Excel.

Plot application software and tidal data are processed using the Admiralty method, while bathymetry maps are processed with Arcview, a global mapper and Surfer application software.

No	Data	Status	Year	Source
1	Rainfall And Wind	Secondary	2013	Maritime BMKG East Java
2	Waves	Secondary	2013	Naval Hidro-Oceanographi and BMKG
3	Tidal	Secondary	2013	Naval Hidro-Oceanographi
4	Sea Current	Secondary	2013	Naval Hidro-Oceanographi and BMKG
5	Tuban district general condotions		2012	Tuban district BPS



2.6. Data processing

Wind data, rainfall, surface sea currents, and waves are processed in several stages using WR

2.7. WR Plot Analysis

There are three types of wind data analysis performed, namely 1-year mouthly wind data, seasonal wind data, and 1-year hourly wind data from January-December 2013

- Monthly wind data

  Monthly wind data obtained from hourly wind data, processed and presented in the form of diagrams called wind roses that serves to determine the dominant wind direction. The processing is done as follows:

  Wind data are grouped according to direction and speed. In each direction of the wind, the speed is divided into seven parts, namely the wind with speeds <1 knot, 1-4 knots, 4-7 knots, 7-11 knots, 11-17 knots, 17-21 knots, and> 22 knots. The amount of wind data that has been divided according to direction and speed is regrouped based on the wind month that blows, so that monthly wind data is obtained within 1 year. Then the percentage is calculated for each direction and speed and presented in graphical form.

- Seasonal wind data

  Seasonal wind data is obtained from hourly wind data each season, processed, and presented in diagram form. The processing is done utilizing wind data grouped based on their direction and speed. In each direction of the wind, the speed is divided into seven parts namely wind with speeds <1 knot, 1-4knot, 4-7knot, 7-11 knots, 11-17 knots, 17-21 knots, and > 22 knots. The number of wind data that have been divided according to direction and speed are regrouped based on the blowing wind season, so that seasonal wind data is obtained within a period of 1 year, namely the west season December-March, the transition season beginning in April-May, the east season June-September and the season the transition from the end of October to November, then the percentage is calculated for each direction and speed, and presented in graphical form.

- 1-year wind data

  One-year wind data obtained from hourly wind data, processed and presented in diagram form. Wind data are grouped according to direction and speed. Each direction of the wind, the speed is divided into seven parts namely wind with speeds <1 knot, 1-4knot, 4-7knot, 7-11 knots, 11-17 knots, 17-21 knots, and> 22 knots. The amount of wind data has been divided according to direction and speed, so that wind data obtained within A period of 1 year.

  For breaking waves after a significant wave height value is obtained, then grouping H Significant and T significant every month for 1 year, using the equation formula.

  H_{10} = average wave height of the highest 10% wave. average wave height of 33% highest wave height This wave height is usually called a significant wave height (significant wave height) while to determine the wave period the same method is used but for a significant wave height. The period is done in two ways $T_{33} = T_{1/3}$ = the average wave period of the 33% highest wave or the average wave period of all records (not so different) except when the energy spectrum is caused by two types of waves namely sea and swell. The breaking wave boundary conditions are expressed in equation (1)

$$\left(\frac{H}{L}\right)_{MAX} = \frac{1}{7}\tanh\left(\frac{2\pi d}{L}\right) \qquad (1)$$

  At sea in the equation becomes equation (2)

$$\left(\frac{H_0}{L_0}\right)_{MAX} = \frac{1}{7} = 0{,}142$$

(2)

  If the wave moves towards the shallow sea, the slope of the boundary depends on the relative depth of d / L and the slope of the seabed.

Waves from the deep sea that moves towards the coast will increase its slope until finally it is unstable and breaks at a certain depth. The formula for determining the height and depth of a breaking wave with equation (3)

$$\frac{db}{Hb} = \frac{1}{b - \left(\frac{aHb}{gT^2}\right)} \qquad (3)$$

b and a are beach slope functions m and are given by equations (4) and (5)

$$a = 43{,}75\,(1 - e^{-19m}) \qquad (4)$$

$$b = \frac{1{,}56}{(1 + e^{-19{,}5m})} \qquad (5)$$

Determination of breaking wave height and depth of the breaking wave using Graphs

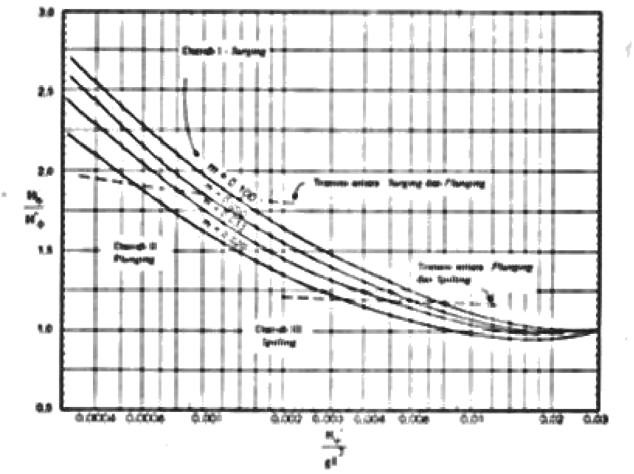


Figure Determination of Breaking Wave Height (Source: Triatmodjo, 2008)

With known wave height and wave period, beach slope and angle of incidence, the refraction coefficient will be known so that the calculation will produce a value Hb/H'0 dan H'0/gT² so that through the wave determination chart, we will get the type of breaking wave, whether it is Spilling, Plunging, Surging or Collapsing. Harmonic Analysis. Analysis of tidal data from January to December is processed by Microsoft Excel and office using the Admiralty method. Formzahl values will be obtained.

$$F = \frac{A(K1) + A(O1)}{A(M2) + A(S2)}$$

With

F = Formzahl values

A = Amplitude Values

K_1 = Pricipal lunar diurnal with estimate 25.82 time

O_1 = Luni-solar diurnal with istimate 23.93 time

M_2 = Principal solar with estimate 12.00 time

S_2 = Principal lunar with estimate 23.93 time

Sea Map Analysis in determining the beach gradient

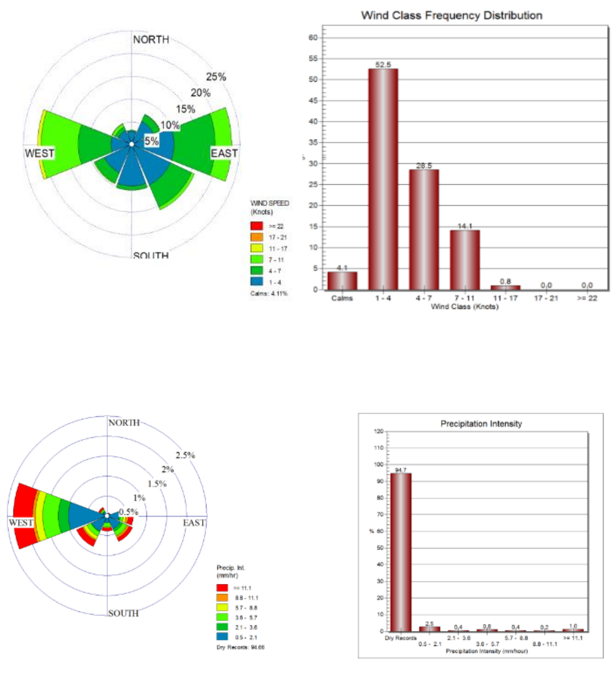
$$\tan \emptyset = \frac{\Delta y}{\Delta x}$$

For y are the sea depth to bottom and X horizontal line from zero coastlines to a certain depth. Positive tangent values in quadrants I and III and negative in quadrants II and IV.

3 RESULT AND DISCUSSION

3.1 Wind and rainfall

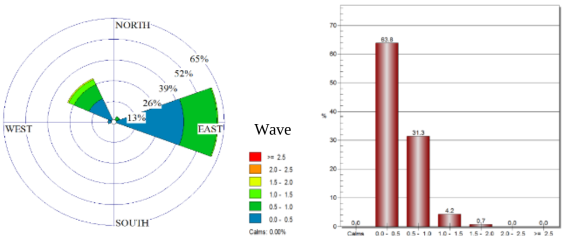
In the coastal waters of the Tuban, the most winds blow from the east to reach 23.5%, while from the west 21.5%, from the southeast 16% with a maximum speed of 14.87 knots. Most rainfall from the west reached 2.4%, from the southwest 0.8%, and from the southeast, 0.65% with a maximum rainfall intensity of 56 mm / h weather prediction in 2013 showed a long dry season.



Thematic Records of Wind Roses and Rain Roses for one year

3.2. Ocean waves

From the analysis of the wave data presented in the Wave Rose and Wave Class, it can be seen that differences occur during the season, in the west season during December-March the maximum wave height reaches 2 m, the transition period early in the year ie April-May the maximum wave height reaches 1 m and in the east monsoon during June-September the maximum wave height is equal to the beginning of the year transition season which reaches 1 m.

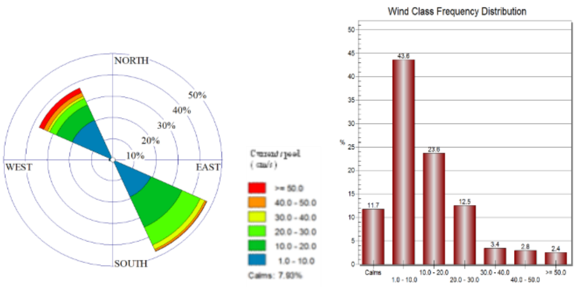


WAVE HEIGHT DATA, PERIOD AND WAVE TYPES THE COASTAL WATER OF TUBAN IN 2013					
Month	Significant H (m)	Significant T (s)	Hb / H'0	H'0 / gT²	Wave Types
JANUARY	1,15	5,10	1,02	0,0042	SPILLING
FEBRUARY	0,97	4,93	1,07	0,0037	SPILLING
MARCH	0,47	4,19	1,21	0,0026	SPILLING
APRIL	0,39	4,20	1,28	0,0021	TRANSITION
MAY	0,51	4,49	1,23	0,0024	SPILLING
JUNE	0,48	4,70	1,30	0,0021	TRANSITION
JULY	0,83	5,12	1,16	0,0029	SPILLING
AUGUST	0,72	4,81	1,15	0,0029	SPILLING
SEPTEMBER	0,70	4,89	1,17	0,0027	SPILLING
OCTOBER	0,43	4,18	1,23	0,0023	TRANSITION
NOVEMBER	0,35	4,08	1,29	0,002	TRANSITION
DECEMBER	0,72	4,73	1,14	0,003	SPILLING

Wave Rose Thematic Record and Wave Data for one year

3.3. Ocean currents

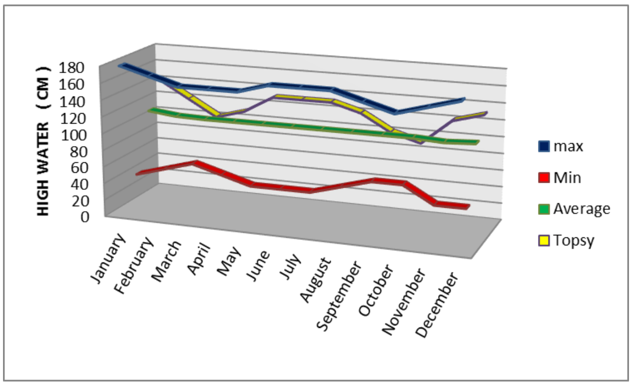
In Tuban coastal waters during 2013 the maximum surface sea current velocity of 76.47 cm / s reached 2.4%. the dominant flow to the southeast reaches 49% and to the northwest reaches 38% and slightly to the west 3%.



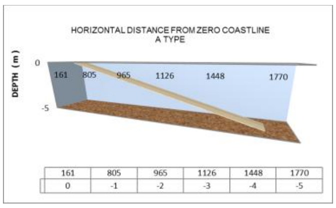
3.4. Tidal

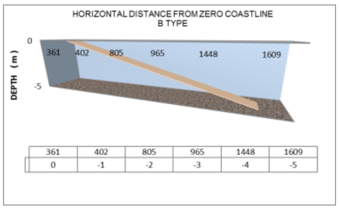
	S0	M2	S2	N2	K1	O1	M4	MS4	K2	P1		
THE FINALY RESULT											F = 5.5	JANUARY
A Cm	110	5	6	0	39	22	0	1	2	13	SINGEL	
g°		212	46	9	277	21	192	349	46	277	(DIURNAL)	
THE FINALY RESULT											F = 5.9	FEBRUARY
A Cm	110	4	6	1	39	20	0	1	2	13	SINGEL	
g°		201	45	171	278	15	329	337	45	278	(DIURNAL)	
THE FINALY RESULT											F = 5.7	MARCH
A Cm	105	4	7	2	38	25	0	1	2	13	SINGEL	
g°		231	48	93	277	17	19	17	48	277	(DIURNAL)	
THE FINALY RESULT											F = 5.2	APRIL
A Cm	105	5	7	0	40	22	0	1	2	13	SINGEL	
g°		210	44	281	277	14	82	8	44	277	(DIURNAL)	
THE FINALY RESULT											F = 5.5	MAY
A Cm	105	5	6	0	40	21	0	1	2	13	SINGEL	
g°		212	45	67	278	23	235	22	45	278	(DIURNAL)	
THE FINALY RESULT											F = 6.3	JUNE
A Cm	105	5	5	1	39	24	0	1	1	13	SINGEL	
g°		222	45	259	278	25	312	329	45	278	(DIURNAL)	
THE FINALY RESULT											F = 5.3	JULY
A Cm	105	5	6	1	38	20	0	1	2	13	SINGEL	
g°		216	53	233	277	14	299	11	53	277	(DIURNAL)	
THE FINALY RESULT											F = 5	AUGUST
A Cm	105	6	6	1	38	22	0	1	2	13	SINGEL	
g°		211	52	78	277	25	252	3	52	277	(DIURNAL)	
THE FINALY RESULT											F = 4.9	SEPTEMBER
A Cm	105	5	7	0	39	20	0	1	2	13	SINGEL	
g°		215	57	163	275	19	308	334	57	275	(DIURNAL)	
THE FINALY RESULT											F = 5.5	OCTOBER
A Cm	105	5	6	0	40	21	0	1	2	13	SINGEL	
g°		217	52	48	276	20	97	23	52	276	(DIURNAL)	
THE FINALY RESULT											F = 6.1	NOVEMBER
A Cm	105	5	5	1	39	22	0	0	1	13	SINGEL	
g°		218	53	43	277	26	89	13	53	277	(DIURNAL)	
THE FINALY RESULT											F = 6.2	DECEMBER
A Cm	110	5	5	0	39	23	0	1	1	13	SINGEL	
g°		215	54	187	277	26	357	347	54	277	(DIURNAL)	

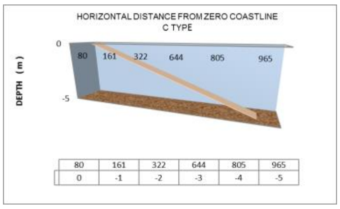
Based on the results of calculations and tables note that throughout the year in the coastal waters of Tuban has a Diurnal or a single daily type that is in one day occurs at high tide and once low tide.

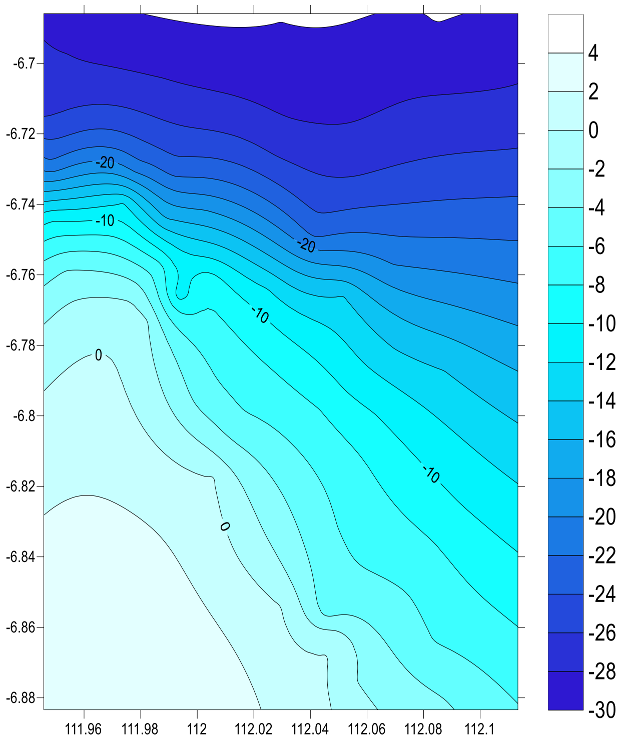


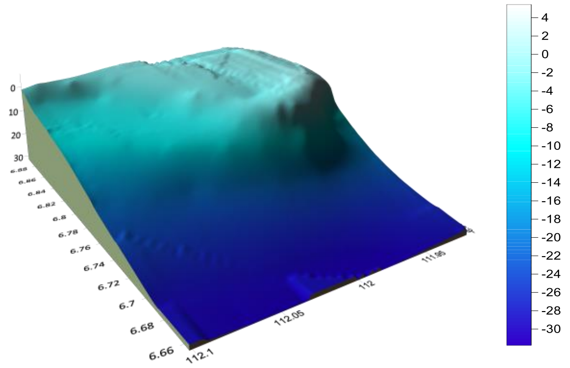
3.5. Bathymetry Map Analysis











Meteo-Oceanographic Data Calculation and Processing Result

No	Month	Rainfall and Wind				Sea Wave			Tidal Sea			Sea Current	
		Speed (Knots)	Blowing From (°)	Intensity (mm/hr)	Blowing From (°)	High (m)	Period (s)	Surf	Tipes	Max (cm)	Min (cm)	Speed (cm/s)	Blowing To (°)
1	January	7,8	272	4,5	272	1,15	5,10	SPILLING	DIURNAL	180	40	27,7	27
2	February	5	233	4,9	233	0,97	4,93	SPILLING	DIURNAL	170	50	12,6	120
3	March	3,9	223	3,9	223	0,47	4,19	SPILLING	DIURNAL	160	60	8,6	78
4	April	4	142	4,7	142	0,39	4,20	TRANSITION	DIURNAL	160	50	5,0	119
5	May	3,5	138	2,9	138	0,51	4,49	SPILLING	DIURNAL	160	50	5,6	317
6	June	3	157	5	157	0,48	4,70	TRANSITION	DIURNAL	170	40	4,0	293
7	July	**4,3**	**128**	**2,6**	**128**	**0,83**	**5,12**	**SPILLING**	**DIURNAL**	**170**	**40**	**15,6**	**390**
8	August	**4,6**	**113**	**0**	**113**	**0,72**	**4,81**	**SPILLING**	**DIURNAL**	**170**	**40**	**24,9**	**297**
9	September	4	116	0	116	0,70	4,89	SPILLING	DIURNAL	160	60	23,0	296
10	October	3,1	141	2,8	141	0,43	4,18	TRANSITION	DIURNAL	150	60	9,6	71
11	November	3	188	2	188	0,35	4,08	TRANSITION	DIURNAL	160	40	7,0	70
12	December	4,7	229	2,5	229	0,72	4,73	SPILLING	DIURNAL	170	40	17,0	68
		Information											

Depth (m)	Demari Beach		Sugih Waras Beach		Awar awar Cape	
0	161	1 : 134	361	1 : 134	80	1 : 65
1	805	1 :644	402	1 : 241	161	1 : 81
2	965	1 : 160	805	1 : 403	322	1 : 161
3	1126	1 : 161	965	1 : 160	644	1 : 322
4	1448	1 : 322	1448	1 : 483	805	1 : 161
5	1770	1 : 322	1609	1 : 161	965	1 : 160

Parameters Comparison of Ideal Conditions with Analysis Results

4. CONCLUSION

From the results of the analysis, it can be concluded that the area of Tuban coastal waters throughout 2013 can be used as a landing site, with the Meteo-Oceanographic analysis the appropriate time to carry out the Amphibian landing ie in July to August while the right landing place is Sugih Waras Tuban beach.

No	Oceanographic Weather Parameters	Ideal Condition	Analysis Results
1	Speed and Wind Direction	Direction Pararel to the beach Maximum Surface wind speed of 13 knots	Demari beach is not pararel Sugih Waras Beach is pararel Awar awar Cape is not pararel
2	Breaking Waves	Spilling Type	All three beaches have Spilling Type
3	Speed and Current Direction	Direction between 60° - 90° Maximum Speed Current	Demari beach is 45° Sugih Waras beach is 60° Awar awar Cape is 90°
4	Tidal	Diurnal Type	All three beaches have Diurnal Type
5	Beach Gradient	Minimum slope 1:30 - 1:60	Demari beach slope 1 : 134 Sugih Waras beach Slope 1 : 134 Awar awar Cape Slope 1 : 65
6	Sea floor Sediment	Sandy	Demari beach is Sandy Mudd Sugih Waras beach is Sandy Awar awar Cape is Muddy
7	Beach Shape	Straight	Demari beach is bumpy Sugih Waras is Straight Awar awar Cape is convex
8	Long beach	For one BTP is 500 meters	Demari beach which can be used 200 meters Sugih Waras beach can be used 500 meters Awar awar Cape can be used 100 meters

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ANALYSIS OF THE ROLE OF CODIFICATION TO SUPPORT THE PLANNED MAINTENANCE SYSTEM (PMS) THE MAIN TOOL OF THE NAVY WEAPONS SYSTEM

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ABSTRACT

The material codification system is deliberately designed to realize effectiveness and efficiency in providing defense logistics support and facilitate better management of equipment and supplies materiel data. The main tool of the navy weapons system consisting of ships, aircraft, marines and bases including personnel who manned. The preparation of adequate logistical support it, will have an impact on the readiness of the main tool of the navy weapons system in carrying out its duties and functions. This research aims to improve the implementation of codification embodied in the completeness of the Material Basic Book (MBB) in The main tool of the navy weapons system so that it will support the preparedness of the Navy in carrying out operations and exercises. To examine the above problems, identification is needed to answer the current problem by using swot analysis method approach. In this approach, the right decision is also done in making decisions using SWOT matrix calculations that can produce the best strategy formulation by providing weight and rating values from internal and external factors against four quadrants so that it is known that the result is in quadrant III which supports turn around strategy with a difference between strength and weakness of 1 while the odds and threats are 2.62.

Keywords: Codification, Supply, and SWOT.

1. INTRODUCTION

"One of the main tasks of the Navy is to uphold sovereignty and law in the waters of national jurisdiction with the configuration of an island nation whose two-thirds of the territory is the sea. The configuration of such areas resulted in the high demand for the readiness and preparedness of the Navy units to carry out operations and exercises, therefore the role of logistics became very decisive in the successful implementation of the Navy Task Force" (Kasal, 2010)

Good Logistics Management will be to increase the efficiency and effectiveness of logistics support to users. Codification System in logistics management has several operational and economic benefits, namely in terms of standardization of equipment. Identifying an Item is a very important part of the material Identification System because in this section will be explained how to establish one unique identification for each supply so as to provide an overview of the important characteristics of an item so as to distinguish from each supply, because each Item has only one identification of the Goods.

NATO Codification System (NCS) is a uniform and simple system for the identification, classification and numbering of supplies (stock) for Materiil Logistic. NCS is a program that allows components and spare parts, especially military needs, to be uniformly named, grouped/classified, and assigned a National Preparation Number (NSN). NSN along with data on goods/items are published in the supply catalog and list of repair parts and used as identification keys in the Logistics Information System. Naval supply center as echelon of supply implementation is tasked in handling all codification of supplies in the Navy. Real form in simplifying the process of codification of all The main tool of the navy weapons system that is by making a manual book namely Material Basic Book (MBB) that can facilitate the request process and in terms of maintenance of the main tool of the navy weapons system. Material Basic Book (MBB) is defined as a basic document of supply containing technical and logistical data of a unit of users, to be used as a basis in determining the needs, demands and control of the supply inventory of the user unit, thus the Material Basic Book (MBB) is used as a basic reference in operationalizing the supply system in the Navy. The main parts of MBB are User Unit Equipment Configuration List (UUECL), Equipment Catalog (EC), Spare Parts Supply List (SPSL), Inventory Supply List (ISL), and Cross Reference List (CRL) is an integral and integral series.

Departing from the limitations in the resources of researchers trying to solve the problems faced in the process of codification of The main tool of the navy weapons system namely the fulfillment of the Material Basic Book (MBB) as a manual book of each the main tool of the navy weapons system so as to help the process of maintenance and demand its. In fact, researchers have found 3 main problems, namely the number of personnel who are still lacking, infrastructure facilities that are not optimal and coordination between institutions that are not optimal. By identifying the 3 problems, we can find out what should be considered for improvement, as the first step is to formulate a policy that is outlined in detail in the process of a strategy and efforts to deal with some obstacles faced in the field at that time.

2. LITERATUR REVIEW

2.1. Development Strategy Theory

Development strategy is an action that demands the decision of the top management in business development to realize it. Development Strategyes also affect the life of the organization in the long term because the nature of a future-oriented development strategy (Amalia, Hidayat, &Budiatmo, 2012).

Development strategy has a function of formulation in considering internal and external factors faced by the company. Strategic announcements include the development of a vision and mission of an enterprice, the identification of opportunities and external threats, the determination of the strength and weakness of the internal organization, set the long-term goals of organization, creating a number of alternative Strategyes for the organization, and choosing specific Strategyes to use (Wheelen &Hunger, 2010).

2.2. Material Codification Of National Preparation Number System (NSN)

The concept of material cataloguing system, by creating a unique code or numbering, on Materiil logistic (Item of Supply) the main tool of the navy weapons system, with the intention of managing the existing materiil / supply, and can draw up a plan of supply needs for ordering supplies properly and quickly so as not to occur demand to Zero (Out of Stock). Improvements to the NSN system continue to be made, including the updating of material data, reference books / instructions continuously until now, by utilizing electronic data processing technology (computer), the updating of material data can be done quickly and distributed quickly to all countries of NCS system users in the world, with the intention of uniformity in identifying materiil, such as setting the default name, stating material descriptions, characteristics, material usability, and many other data. With the continued increase of The main tool of the navy weapons system coming from abroad, and dependence on the re-provision of spare parts in the manufacturer country still remains, as well as the rapid growth of industry in Indonesia, where some of their products also support the State Defense Logistics, the need for material cataloguing of NSN systems becomes very important, to be able to go to a modern and effective defense logistics system, therefore the material cataloguing of NSN systems in Indonesia can no longer be just a user, but has increased to become a participant in the union of countries that are users of cataloguing NSN systems in the world.

2.3. SWOT Analysis

SWOT analysis is an effective strategy based on internal factors (strengths and weaknesses) and also external (opportunities and threats) of organization. Therefore, this analysis combines the four factors from internal and external, then can be explained in the SWOT matrix image. In the positioning of an organization there are the following provisions:

Quadrant I : Is a very lucrative situation. The organization has opportunities and strengths so that it can take advantage of existing opportunities. The strategy that must be applied in this condition is to support an aggressive growth policy (Growth oriented strategy).

Quadrant II : Company position is good, but we need to be careful because we're going to face a challenge. One of the strategies that can be done is to diversify strategies by looking for new opportunities that have not been touched before.

Quadrant III : This quadrant reflects that the company's performance is below average, but there are opportunities that are still open, it takes courage to change the old strategy.

Quadrant IV : In this quadrant is an unfortunate situation because it has various internal weaknesses and faces various threats.

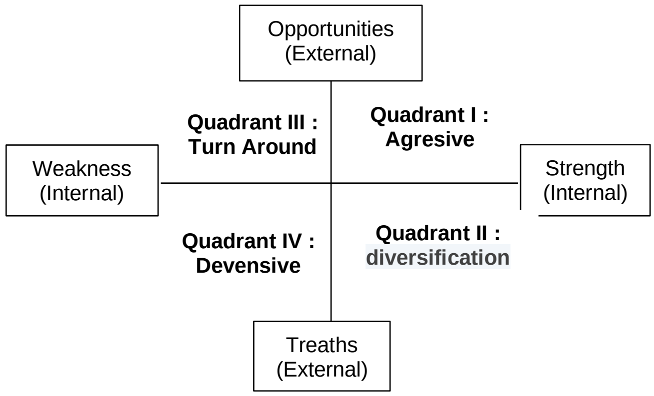

Figure 2.1 SWOT Analysis Diagram Source: (Rangkuti, 2018)

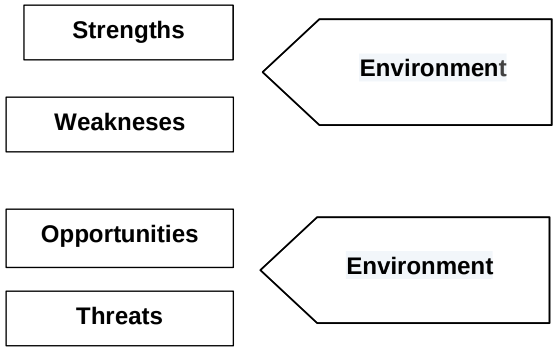

Figure 2.2 Schematic of Source SWOT Stages (Rizal, 2015)

3. RESEARCH METHODS

In this research process the authors used a mixed approach that is qualitative and quantitative. This research is presented with descriptive and figures, ranging from data collection, processing of data and the appearance of the results. This research was conducted in four stages, namely the preliminary stage, data collection, data processing, analysis and the last Stage of Conclusion and Advice. Shown in the flow chart as follows:

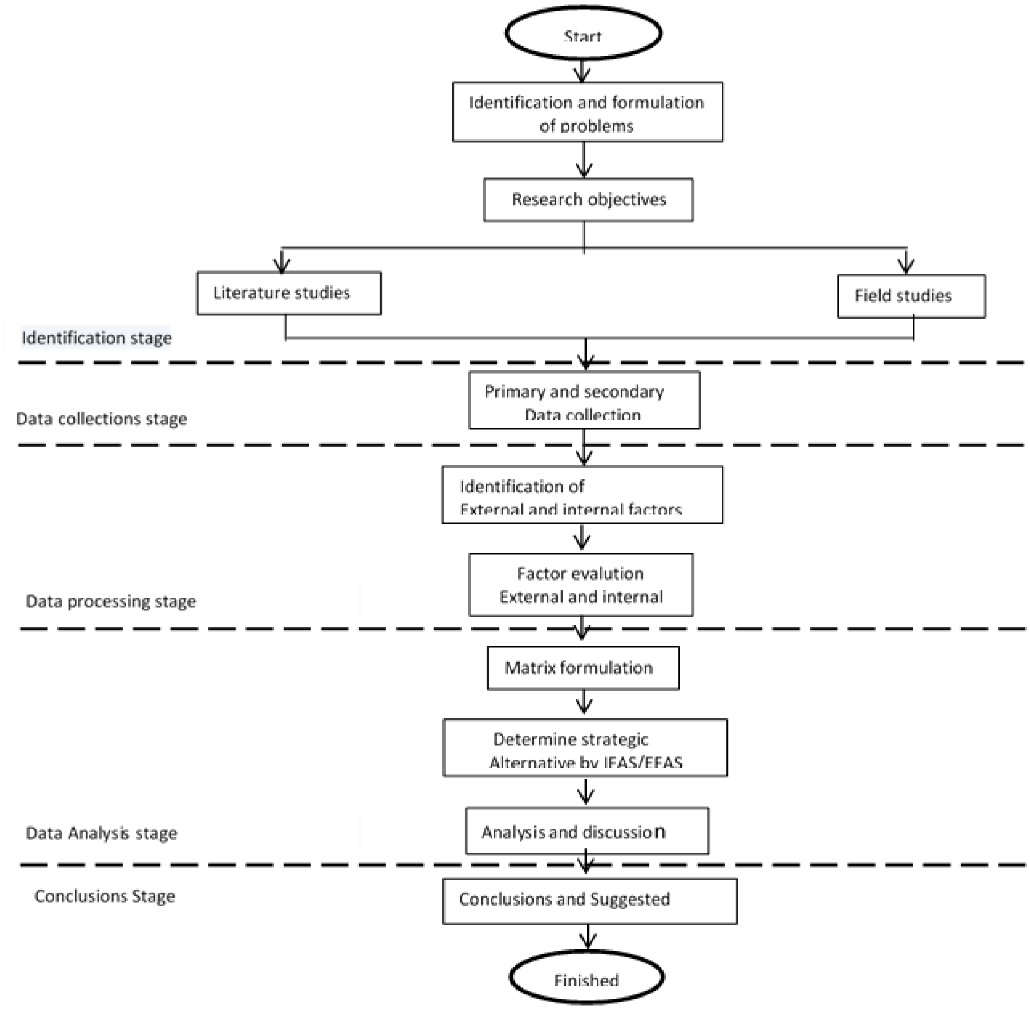

Figure 3.1 Research Flowchart

In preliminary stage consists of Problem Identification, Determination of research objectives, Literature Studies, Field Studies. At the stage of data collection, namely data that supports the process of data processing. At the stage of data processing is carried out Matrix calculation steps by giving weight value and rating first. At the analysis stage, the analysis of the calculation results that have been contained in the quadrant will be used as an option of Strategyes and efforts in completing the compounding. At the conclusion stage, conclusions were drawn from the research that has been done as well as suggestions for further research related to this research.

4. RESOURCE AND DISCUSSION

Strategyes that are derivatives of the policy, can be prepared to provide certainty or assurance that all existing problems will be answered by considering the factors of opportunity and constraints (threat) and using the capital strength (strength) and weaknesses (weaknesses) of logistical support that have been identified in the discussion of current conditions by paying attention to the indicators of success. SWOT analysis is used to identify Strategyes to be formulated.

4.1 Internal and External Weight Calculations and Analysis

Table 4.1 and Table 4.2 result of calculation of internal and external factor weights. Table 4.3 presents the Internal Matrix of Summary Analysis

Factors (IFAS) and the External Matrix of The Summary Analyst Factor (EFAS). From the results obtained in Table 4.3 on internal factors strengths and weaknesses get the total calculation of each indicator with a strength weight value of 0.55 and a total score of 3.86 and at weakness get a total weight value of 0.45 and a score of 1. Internal factor analysis using efas table is used to formulate external strategy factors of analysis results in terms of opportunities, threats to weight value and rating in the table. From the results obtained in Table 4.2 on external factors opportunities and threats get a total calculation of each indicator with a chance weight value of 0.52 and a total score of 3.56 and on threats get a total weight value of 0.48 and a score of 0.94.

Formulation of Internal Factors

After the existing data is collected, internal factors are formulated through questionnaire filling by stakeholders as seen in table 4.1.

Formulation of External Factors

As in the formulation of internal factors, the next step is calculating weighting based on stakeholder assessment to obtain the classification of opportunity factors and challenge factors (Threat) as seen in table 4.2.

Table 4.1 Calculation of Internal Factors

NO	INTERNAL FACTORS	WEIGHTS	RATING	SCORE WEIGHTS
	POWER			
1	Sub Codification is a special unit that handles the codification and cataloguing of the Navy	0.1	9	0.9
2	Personnel capabilities in the MBB manufacturing process	0.09	8	0.72
3	Course implementation Kataloger Specifications	0.08	5	0.4
4	Supporting facilities and infrastructure	0.1	6	0.6
5	Good network connection	0.07	6	0.42
6	Up date and Up grade soft ware support/program from Kemhan Codification Center	0.06	7	0.42
7	Soft ware and hard ware support	0.05	8	0.4
TOTAL		**0.55**		**3.86**
	WEAKNESS			
1	The number of personnel is not yet DSP compliant	0.1	1	0.1
2	Some kataloger qualified personnel	0.08	3	0.24
3	Delayed proposal of supporting facilities and infrastructure	0.07	3	0.21
4	A network connection has been disrupted	0.06	3	0.18
5	Workload in the manufacture of MBB All The main tool of the navy weapons system	0.05	2	0.1
6	Interference occurs on up date and up grade soft ware support/program	0.04	3	0.12
7	The Need for Coordination With Relevant Stakeholders	0.05	1	0.05
TOTAL		**0.45**		**1**
TOTAL IFAS		**1**		**4.86**

Table 4.2 Calculation of External Factors

NO	EXTERNAL FACTORS	WEIGHTS	RATING	SCORE WEIGHTS
	OPPORTUNITIES			
1	Conducting cooperation with The Center for Codification in the Ministry of Defense for coding	0.12	7	0.84
2	Carrying out kataloger course cooperation	0.11	8	0.88
3	Support facilities and infrastructure from The Center for Codification in the Ministry of Defense in collaboration with Dislogistic	0.1	7	0.7
4	Technological advancements for the development of codification and cataloguing	0.09	6	0.54
5	Budget support in the socialization of The main tool of the navy weapons system Codification	0.1	6	0.6
TOTAL		Total		**3.56**
	THREAT			
1	Completeness of supporting document books on the manufacture of MBB The main tool of the navy weapons system	0.1	2	0.2
2	Implementation of validation to Satkai that has not been optimal	0.09	3	0.27
3	Fulfillment of personnel according to DSP	0.11	1	0.11
4	MBB completeness requirements for The main tool of the navy weapons system are not included in the procurement clause	0.08	2	0.16
5	Up date and Up grade soft ware support/program from Paid Pengada	0.1	2	0.2
TOTAL		Total		**0.94**
TOTAL IFAS		**1**		**4.5**

4.2 Cartesius Swot Analysis Diagram

Make a Cartesian diagram of a SWOT analysis from the result of the processing of internal and external factors in Figure 1 which can be from ifas matrix and EFAS matrix. The data input is the total of the multiplication between (rating x bobt). Here's an overview of the matching stages used by the matrix Swot. The following diagram diagrams cartesius SWOT analysis of the role of Codification to support the Planned Maintenance System (SPT) The main tool of the navy weapons system in the Navy

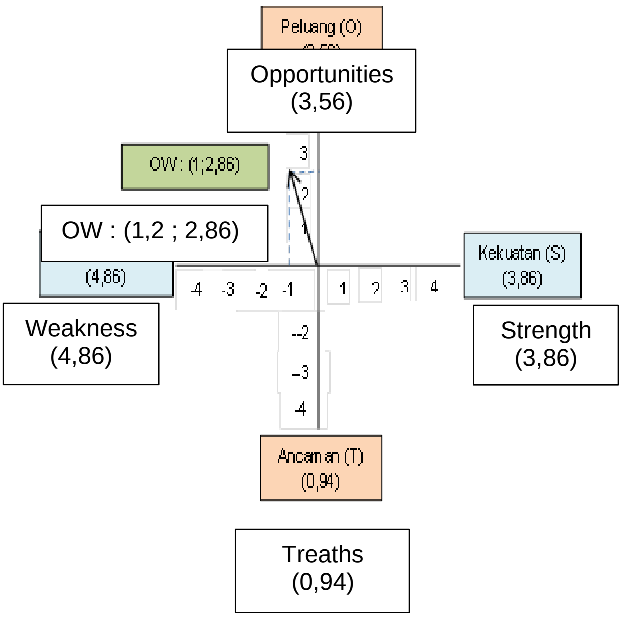

Figure 4.1 Cartesius Diagram of SWOT Analysis of The Codification of The main tool of the navy weapons system TNI AL

4.3 SWOT Matrix

SWOT matrix produces some alternative strategies obtained from internal and external variables according to the position of company on the internal external matrix is grow and build strategy. Alternative strategy obtained as follows : SO, ST, WO, and WT Strategyes. Alternative strategy can used to carry out future development Strategyes. The combination of matrix strategy is obtained from the combination of internal and external factors, the result can be seen in table 4.3.

Table 4.3 SWOT Matriks

IFAS / EFAS			**POWER**		**WEAKNESS**
		1	Sub Codification is a special unit that handles the codification and cataloguing of the Navy	1	The number of personnel is not yet DSP compliant
		2	Personnel capabilities in the MBB manufacturing process	2	Some kataloger qualified personnel
		3	Course implementation Kataloger Specifications	3	Delayed proposal of supporting facilities and infrastructure
		4	Supporting facilities and infrastructure	4	A network connection has been disrupted
		5	Good network connection	5	Workload in the manufacture of MBB All The main tool of the navy weapons system
		6	Up date and Up grade soft ware support/program from Kemhan Codification Center	6	Interference occurs on up date and up grade soft ware support/program
		7	Soft ware and hard ware support	7	The Need for Coordination With Relevant Stakeholders
	EXTERNAL FACTORS		**SO Strategy**		**WO Strategy**
1	Opportunities	1	Integration of information and technology with The Center for Codification in the Ministry of Defense	1	Adding personnel up to DSP compliant
2	Conducting cooperation with the Center for Codification in the Ministry of Defense for coding	2	The Center for Codification in the Ministry of Defense holds Kataloger specialization courses according to their level	2	Conducting Kataloger specialization courses according to their level
3	Carrying out kataloger course cooperation	3	Supporting facilities and infrastructure for smooth work	3	Improve network connection capabilities in supporting tasks
4	Opportunities	4	Improved personnel soft skills to improve quality	4	Coordination with The Center for Codification in the Ministry of Defense and stakeholders related to procurement
5	Conducting cooperation with The Center for Codification in the Ministry of Defense for coding				

	Carrying out kataloger course cooperation		**ST Strategy**		**WT Strategy**
1	Support facilities and infrastructure from the Center for Codification in the Ministry of Defense in collaboration with Dislogistic	1	Use funding support as effectively and efficiently as possible for planned activities	1	Manage personnel work to be effective and efficient
2	Technological advancements for the development of codification and cataloguing	2	Carrying out validation and checking the completeness of supporting documents in the field	2	Improving personnel capabilities by carrying out Training in Service (LDD)
3	Budget support in the socialization of The main tool of the navy weapons system Codification	3	Improving personnel capability in the MBB manufacturing process by carrying out courses and Training in Dinas (LDD)	3	Improve network connection capabilities and hard ware and soft ware capabilities
4	Threat	4	Coordinating with the government office in terms of procurement clause The main tool of the navy weapons system to include the manufacture of MBB		
5	Completeness of supporting document books on the manufacture of MBB The main tool of the navy weapons system				

The result of the combination formula of SO, ST, WO, and WT from the IFAS-EFAS factor results in an alternative strategy that gets the highest weight is Weakness–Opportunity (WO). The following are the result of a combination of Strategyes that include:

a. SWOT Matrix Analysis for SO Strategy

The power used to take advantage of the opportunities can improve combination of information and technology with the center for the codification of the ministry of defense, It's held a specialization course Kataloger according to its level, Supporting facilities and infrastructure for smooth work, Improvement of personnel soft skills to improve quality.

b. SWOT Matrix Analysis for WO Strategy

From weaknesses and opportunities can be prepared Strategyes to minimize existing weaknesses so as to take advantage of opportunities and determine Strategyes by Adding personnel to the appropriate DSP, Conducting courses specialization kataloger according to its level, Improving the ability of network connections in supporting tasks, Coordination with the center for the codification of the ministry of defense and stakeholders related to procurement.

c. SWOT Matrix Analysis for ST Strategy

Seen from the site the strength and threat of using its power to overcome the threat that can come at any time, namely by using the support of funds as effectively and efficiently as possible for the planned activities plan, Carrying out validation and checking the completeness of supporting documents in the field, Improving the ability of personnel in the process of making MBB by carrying out courses and exercises in the Service (LDD), Coordinating with the service in terms of procurement klausal The main tool of the navy weapons system to support the manufacture of MBB.

d. SWOT Matrix Analysis for WT Strategy

On weaknesses and threats that exist can be minimized internal weaknesses to avoid external threats, namely Manage personnel work to be effective and efficient, Improve personnel capabilities by carrying out Training in Service (LDD), Improving network connection capabilities and hard ware and soft ware capabilities

4.4 Proposed Development Strategys

After performing the SWOT matrix strategy combination then make quantitative model analysis as the basis of the number of score values on each factor in each strategy SO, ST, WO, and WT, here's an overview Quantitative model of strategy formulation in view of Table 4.3. Table 4.3 shows that the role of Codification to support the Planned Maintenance System (SPT) The main tool of the navy weapons system in the Navy needs to utilize opportunities strategy and minimize weakness (WO) which has the highest score of 8.42, then the second rank followed by strength and opportunities (SO) 7.42 and subsequently weakness and treaths (WT) 5.8, the latter strength and treaths (ST) 4.8. The strategy that has the highest value is WO by improving the integration of information and technology with The Center for Codification in the Ministry of Defense , The Center for Codification in the Ministry of Defense held a specialization course Kataloger according to its level, Supporting facilities and infrastructure for smooth work, Improvement of personnel soft skills to improve quality.

IFAS	Strength (S)	Weakness (W)
	Strategy SO :	Strategy WO :
Opportunities (O) :	Using Strength to take advantage of opportunity = 7.42	Minimize weakness by taking advantage of opportunity = 8.42
	Strategy ST :	Strategy WT :
Treaths (T) :	Using strength to overcome threats = 4.8	Minimize weakness avoiding threats = 5.8

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

From the discussion that has been described and based on the data the writer obtained from the research as discussed, the following conclusions can be drawn :

a. The identifiable factors in the SWOT analysis consisting of 10 external and 14 internal factors. The internal strength factor has 7 elements. On internal factors weakness consists of 7 elements. Furthermore, the determination of external factors of opportunity consists of 5 factors. On the threat factor has 5 elements of factors.

b. Based on data from the internal and external factors, the next step is to formulate a strategy based on each aspect. The strategy formulation consists of four parts, namely SO, WO, ST and WT Strategyes, each of which consists of three substrates.

After the weighting was obtained the result that the role of Codification to support the Planned Maintenance System (SPT) The main tool of the navy weapons system in the Navy is in quadrant III with the chosen strategy namely WO strategy. The strategy consists of three sub strategycs, namely:

1) Carry out socialization about the importance of completeness of new The main tool of the navy weapons system documents Carrying out each stage of the planned strategy by utilizing technological developments.

2) Conducting careful planning and coordination with the complainant for the involvement of MBB members in the MBB manufacturing process.

3) Perform document data validation by checking directly to the mounted aircraft.

5.2 Suggestion

Based on the conclusions of this study, the following suggestions can be submitted:

a. For the development of science on codification, cataloguing, it is conveyed advice to Chief of Naval Supply Center in this case Chief of Sub Codification always carry out continuous coordination to the relevant parties, namely the Center for Codification in the Ministry of Defense of the Republic of Indonesia, in order to always get information updates and immediately be able to make adjustments as needed.

b. In strategy management there are three stages, namely development, implementation and evaluation. To support the next research is expected to be discussed about the analysis stage of the implementation of the strategy and the plan of the results of the evaluation of the strategy.

c. In this study, there was one strategy from four selected Strategyes. For further research can be used as a reference by discussing alternative Strategyes.

d. In this study, it has not been studied about the calculation of costs in the implementation of the strategy. It is necessary that in the next research an analysis of cost calculations and alternative proposals of Strategyes is needed if the main strategy cannot be implemented.

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FILTERING CTD DATA IN LOMBOK STRAIT TO KNOWING THE SOUND SPEED AND THERMOCLINE CHARACTERISTICS

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ABSTRACT

Lombok Strait is one of 9 chokepoints (narrow point) of the world. Lombok Strait is also one of the 3 lanes of the Indonesian Archipelagic Sea Lanes (IASL) contained in the IASL II which consists of the Makassar Strait and Lombok Strait. Lombok Strait has a depth of more than 150 meters and is a liaison between the Pacific Ocean and the Indian Ocean is very strategic for the submarine trajectory. So it is very important information about the water column in the Lombok Strait for military war operations needs. Therefore, the validity of accurate data is very important, by way of filtering CTD data. The goal is to know the thermocline characteristics and sound speed in the Lombok Strait. One of the methods used for CTD data filtering is by using Analysis Toolpak. Results from CTD data processing using Analysis Toolpak show that there is a difference between data profiles before and after filtering. It also can be seen that the characteristics of the thermocline of the Lombok Strait from North to South are increasingly tight or thin with a thickness of 146.094 meters to 87.694 meters. While the sound speed characteristics in the Lombok Strait from North to South direction also increasingly tight or thin with the difference in the value of sound speed from 34.547 m/s to 27.538 m/s. The seawater mass in the thermocline layer is thought to have originated from the North Pacific Intermediate Water (NPIW) which enters the Lombok Strait through the northern part of the Lombok Strait with an average salinity of 34,415 psu at an average depth of 42.504 meters. Based on the above data it is very important to filter the CTD data to produce valid and accurate data before further processing.

Keywords: *Filtering, Lombok Strait, Sound Speed, Thermocline.*

1. INTRODUCTION

In solving a problem, it is necessary to do an in-depth analysis, therefore it is necessary to support the data obtained from the field as a whole. The data should be quantitative. By using quantitative data the problem becomes clear because the assessment with assumptions that are still guessing, judgment with the words of circumstances or traits (good, bad, long, short, diligent, lazy, and others) can be avoided. Thus misconceptions,misunderstandings, misinterpretations, can be avoided. The analysis becomes directed and detailed, and decision-making will be more accurate.

Data and information as something resulting from data processing become easier to understand and meaningful that describes an event and facts that exist, so it is very useful for leaders in decision making and useful in determining the development of work programs in an institution.

Based on existing facts, conductivity, temperature, and depth (CTD) data from the survey area is directly processed as needed and presented using ocean data view (ODV) software. The results of the display describe the raw data obtained from the survey area conducted. If this is allowed continuously it will adversely affect the accuracy of the data for future surveys. Therefore, there needs to be further processing of CTD data, namely the implementation of filtering or smoothing. Because CTD data obtained from the survey area is still a lot of noise or random data that causes the quality of the data to be poor. With filtering or smoothing, the noise from CTD data obtained from the survey area can be reduced.

Therefore, research on thermocline characteristics and sound speed in the Lombok Strait based on CTD data filtering using Analysis Toolpak is one solution to solve the problem. Because the study discussed filtering or smoothing from CTD data obtained from the survey area. After that, the new filtering or smoothing result data is presented in ODV software and further data processing is carried out.

2. DATA PROCESSING TECHNIQUES

2.1. Interpolation

CTD data obtained from Pushidrosal is done data processing using Macro Excel with a basic visual programming language (VB) which is a script to interpolate lost data. After the CTD data is interpolated, the next step is to filter the CTD data using the Analysis Toolpak in the form of Exponential Smoothing. Inside Exponential Smoothing, there is a dumping factor value that must be filled as an exponential constant for the filtering process. The dumping factor is a correction factor that minimizes the instability of filtered data throughout the observation data. The formula for determining the dumping factor is 1- α (alpha).

2.2. RMSE and MAD Values

RMSE and MAD values are derived from the difference between CTD data and comparison data (WOD and INDESO) after filtering with a value of α 0.1 to 0.9 from downcasting, upcasting, and average CTD data from down-upcasting. After that sought the highest frequency of the smallest values of RMSE and MAD from each downcasting, upcasting, and down-upcasting station to determine the α value suitable for use in the next CTD data filtering process.

2.3. Alpha Value Determination

An α value is a value used to remove noise or random data from CTD data so that the filtering results can be close to the comparison data. The α value itself is between 0<α<1. The α value is used in Exponential Smoothing to determine the dumping factor value used. The formula for determining the α value is as follows.

$$\alpha=\sum freq[\min\{station,RMSE,MAD\}] \quad (1)$$

(Pranowo,W.S.2017,pers.comm)

Once the α value is specified, the dumping factor can be calculated and used for filtering CTD data using Exponential Smoothing. The filtering results are then converted into .txt data to be displayed using ODV software.

2.4 Determination of Thermocline Limits

Calculation of the upper and lower limit depths of the thermocline layer based on the characteristic temperature gradient that is the change in temperature to a depth of 0.1oC for each depth increase of one meter (Nontji, 1987). Bureau (1992) defines a thermocline layer as a depth or position where the temperature gradient is greater than or equal to 0.05oC/m. Based on these definitions, the depth of the upper and lower limits of the thermocline layer can be determined.

The upper limit is the minimum depth at which there has begun to occur a temperature difference greater than or equal to 0.05oC/m with a depth below it, while the lower limit is the final limit that there is still a difference greater than or equal to 0.05oC/m with a depth above it, but it has not occurred 0.05oC/m with a depth below it.

According to Luke and Lindstrom (1991), the depth of each layer in the water column can be known by looking at the change in temperature gradient from the surface to the inner layer. The mixed surface layer is a layer with a temperature gradient of no more than 0.03oC/m (Wyrtki,1961). While the depth of the thermocline layer in water is defined as a depth or position where the temperature gradient is more than 0.1oC depth of 1 meter (Ross,1970).

In this study, a way to determine the thermoclin layer using a temperature gradient of more than 0.1oC/m (Ross,1970). The formula for determining the thermocline layer is as follows.

dT=T2-T1 (2)

dZ=Z2-Z1 (3)

Thermocline=dT/dZ (4)

2.5 T-S Diagram Processing

T-S diagram processing is done using Ocean Data View (ODV) software. The parameter added to create the T-S diagram is the temperature potential obtained from the Derived Variables tool. The next step is to create a diagram by setting Y-variable as potential temperature and X-variable as salinity. After that, the isopycnals function is added to the extras tool so that seawater mass figures are obtained on the diagram (Supangat, 2003).

3. RESEARCH FLOW CHART

The flow chart of the research is as follows.

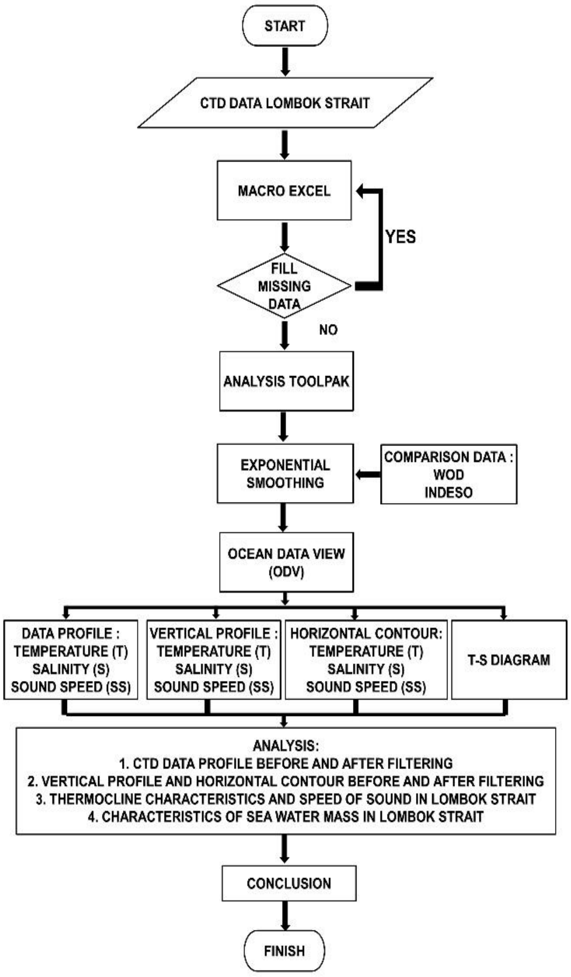

Figure 1. Research Flow Chart

4. RESULTS AND DISCUSSION

4.1. CTD Data Filtering Results

After the alpha value is determined in the dumping factor, then the result of filtering CTD data after it is converted into data .txt can be displayed in ODV software. Filtering CTD data in this study there were 13 CTD stations. The location and one of the profiles of CTD data filtering results are as follows.

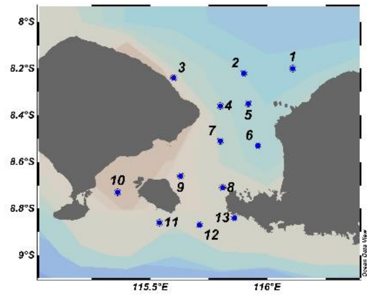

Figure 2. CTD Station Filtering Location

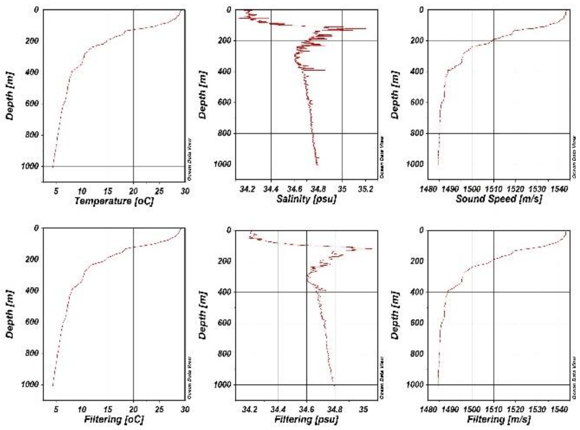

Figure 3. CTD Data Profile Station No.1

From The Picture can be seen the difference between CTD data profile station number 1 before and after filtering. Another CTD data profile can be seen in APPENDIX M. CTD data before filtering there is still noise or data is still rough on temperature, salinity, and sound speed. But after filtering using the Analysis Toolpak, CTD data looks smoother. Based on this research, it can be concluded that filtering CTD data is necessary to obtain valid and accurate data before further data processing.

4.2. Horizontal Plotting Results of CTD Data

The results of horizontal contour plotting in this study at depths of 0, 10, 20, 30, 54, 75, 100, 150, 196, 250, 500, 750 and 1000 meters. The location and one of the results of plotting horizontal contour depth of 54 meters are as follows.

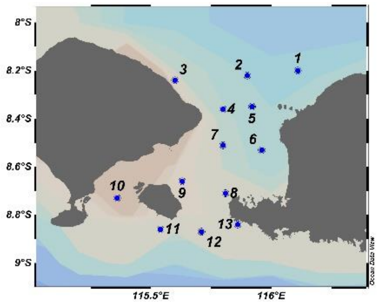

Figure 4. Location of CTD Station Horizontal Contour Depth 54 Meters

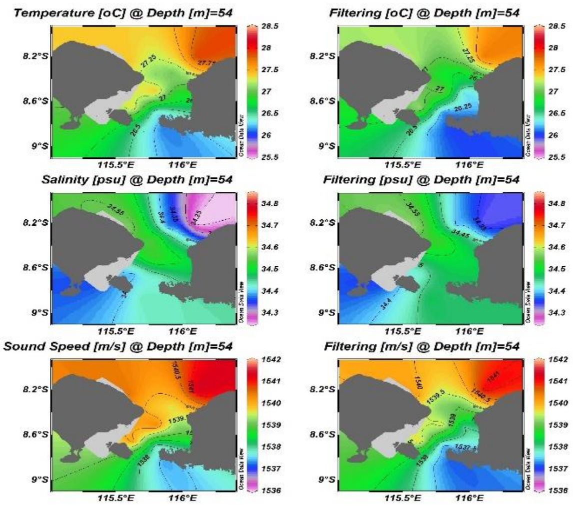

Figure 5. Horizontal Contour Depth 54 Meters

The image above is an image of the horizontal contour of the average upper limit of the 13 CTD station data. In the picture, it can be seen that there is a color difference between CTD data before and after filtering. The color difference is found in temperature, salinity, and sound speed. Based on this research, it can be concluded that filtering CTD data is necessary to obtain valid and accurate data before further data processing.

4.3. Thermocline Layer

Table 1. Upper And Lower Limit Values of Lombok Strait Thermocline Layer

Termoklin	Batas Atas				Batas Bawah				Ketebalan			
	Depth	°C	m/s	psu	Depth	°C	m/s	psu	Depth	°C	m/s	psu
Utara	73.810	25.948	1537.568	34.539	219.905	12.766	1503.021	34.699	146.094	13.181	34.547	0.159
Selatan	51.407	26.363	1537.992	34.430	139.101	15.744	1510.454	34.724	87.694	10.619	27.538	0.294
Barat	57.135	27.074	1539.742	34.530	259.550	11.329	1498.504	34.684	202.415	15.744	41.238	0.154
Timur	41.897	27.043	1539.413	34.397	163.006	16.894	1514.312	34.645	121.109	10.150	25.101	0.249

From the table above can be concluded that the characteristics of the thermocline layer of the Lombok Strait from north to south are getting tighter or thinner with a thickness from 146,094 meters to 87,694 meters or from 202,415 meters to 121,109 meters. While the characteristics of sound speed in the Lombok Strait from North to South are also getting tighter or thinner with the difference in sound speed value from 34,547 m/s to 27,538 m/s or from 41,238 m/s to 25,101 m/s. Similarly, the difference in temperature value is also increasing

Meeting. Different for the difference in salinity value becomes increasing or thicker.

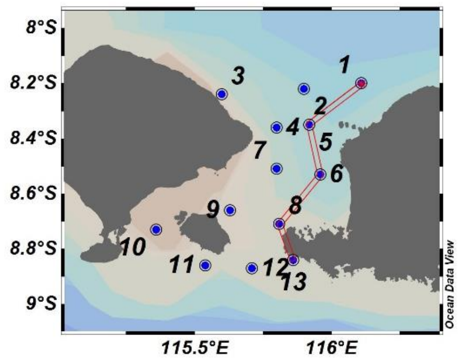

Figure 6. East Cross Section of Lombok Strait

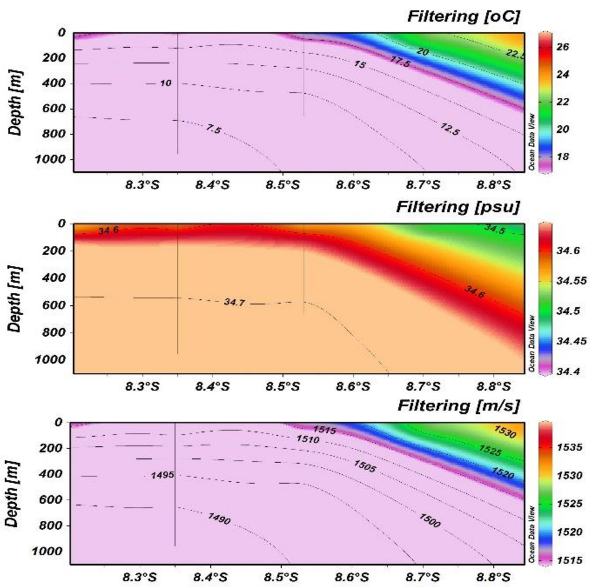

Figure 7. Vertical Profile of The Eastern Thermocline Layer of the Lombok Strait

4.4. Temperature-Salinity Diagram

The plotting results of the temperature-salinity diagram of the five CTD stations are as follows.

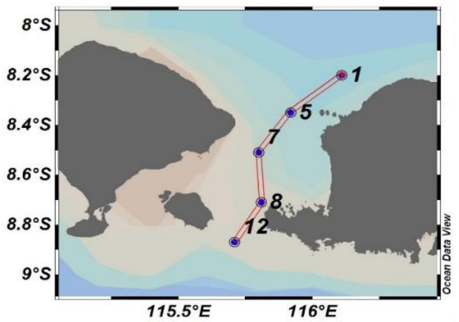

Figure 8. Fifth Cross Section of CTD Station in Lombok Strait

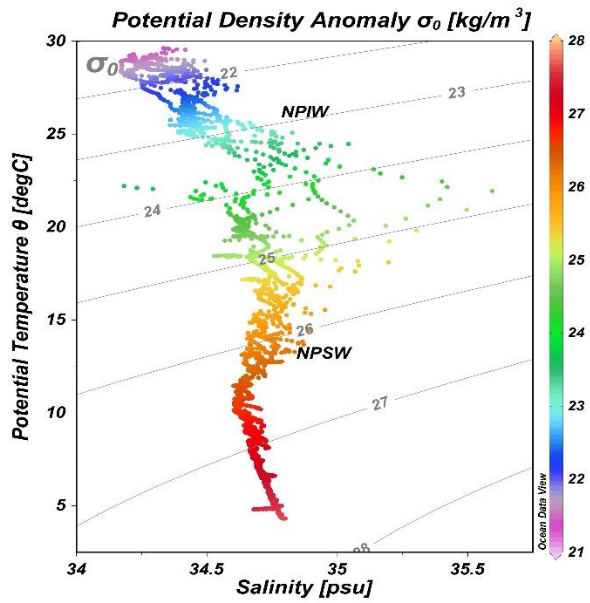

Figure 9. Cross Section Result T-S Diagram

Table 2. T-S Chart Upper and Lower Border Values

Stasiun	Batas Atas				Batas Bawah				Ketebalan
	Depth	°C	m/s	psu	Depth	°C	m/s	psu	m
1	80.410	26.281	1538.407	34.376	235.522	11.916	1500.450	34.698	155.112
5	44.707	27.379	1540.254	34.362	239.432	12.367	1501.933	34.658	194.725
7	51.697	27.914	1541.477	34.542	301.079	9.741	1493.548	34.685	249.382
8	20.807	27.659	1540.377	34.464	129.365	19.293	1521.236	34.569	108.558
12	14.900	28.190	1541.284	34.332	126.236	13.940	1505.189	34.806	111.336
Mean	42.504	27.485	1540.360	34.415	206.327	13.451	1504.471	34.683	163.823

The results of the T-S diagram of the five CTD research stations in the Lombok Strait can be seen in the figure above. From the diagram, it can be known that the Lombok strait from north to south has the following characteristics of seawater mass; Seawater mass in the upper layer of thermocline based on the T-S diagram is to have a σ0 in the range of 21-22.6. Then, the mass of seawater in the thermocline layer, has the characteristic value of seawater mass σ0 in the range of 22.6-23.2, while in the lower layer the thermocline has the characteristic value of seawater mass σ0 in the range of 23.2-27.7. The mass of seawater in the thermocline layer is thought to have originated in the North Pacific Intermediate Water (NPIW) entering the Lombok Strait through the northern part of the Lombok Strait is evidenced by the average salinity value of 34,415 psu at an average depth of 42,504 meters by the range of salinity value measurements taken by Wijffels et al,2002 and You,2003 of 34.4 psu. While the mass of seawater in the lower layer of the thermocline is thought to come from North Pacific Subtropical Water (NPSW) at an average depth of 206,327 meters with an average salinity value of 34,683 psu while the reference salinity value is 34.65 psu (Wijffels et al.2002 and You.2003).

5. CONCLUSIONS

Based on the results of CTD data processing and the results of discussions that have been carried out in this study, it can be drawn some conclusions as follows:

a. CTD Data Profile Lombok Strait before and after filtering there are some differences, therefore the need to filter data CTD before further data processing using Analysis Toolpak.

b. Vertical profile display and horizontal contour of Lombok Strait CTD data before and after filtering there are several differences, so it will affect the results in the analysis process of determining the thermocline layer.

c. The characteristic of the thermocline in the Lombok Strait from North to South is that it is getting tighter or thinner which was originally 146,094 meters thick to 87,694 meters, as well as the speed of sound that is decreasing with the difference in sound speed value from 34,547 m/s to 27,538 m/s.

d. In the Lombok Strait, there are two different seawater masses from the surface to a depth of about 200 meters. The mass of NPIW seawater originating from the Okhotsk Sea and the Gulf of Alaska was detected at an average depth of 42,504 meters and the mass of NPSW seawater coming from the shallow subtropical in the North Pacific was detected at an average depth of 206,327 meters.

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ASSESSMENT OF OCCUPATIONAL SAFETY AND HEALTH RISKS BASED ON A RISK MANAGEMENT SYSTEM AND THE SELECTION OF ALTERNATIVE IMPROVEMENTS

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ABSTRACT

Work accidents, especially in the industrial world, must be an essential concern because they involve and individual health and safety in the surrounding environment. At Squadron 900 / Fasharkan Puspenerbal Juanda, there were quite a lot of work accidents. The causes of work accidents vary, from mechanical aspects (equipment and machines) to parts of hazardous materials. The use of Hazmat mainly causes work accidents in squadron 900/Fasharkan, primarily in department IV. Therefore in this study only discuss hazardous materials as a cause of work accidents.The research conducted is the identification of risks in department IV (Department of Frame, AKP and Motor) Squadron 900 / Fasharkan, especially the Division of Frame and Mechanical Division using the approach of Risk Management System. In this approach, a risk ranking is carried out using FMEA, and further efforts a made to make improvements to reduce the risk of hazards. The improvement efforts- selected from several alternative solutions that have made using the NPV approach. With the Net Present Value approach, it is possible to compare the existing alternative solutions financially.

Keywords: Risk Management, Occupational Health and Safety (K3), Hazardous materials, Net Present Value (NPV)

1. INTRODUCTION

Work accidents have become a classic problem in the industrial world, especially in the manufacturing industry such as Squadron 900, a maintenance workshop for the Juanda Puspenerbal aircraft whose position is under the maintenance and repair facility of the Juanda Penerbal. Squadron 900 / Fasharkan still involved many dangerous tools and materials that could cause accidents for workers. However, that does not mean that the company management can ignore this classic problem because it involves the safety of its workers.

At Squadron 900 / Fasharkan Juanda's Puspenerbal, especially department IV (the frame, Aviation and Motorcycle safety equipment) there are many dangerous chemicals, such as flammable paint and toxins from rusty equipment, residue from the painting process in the form of flying powders. In the air and some other hazardous materials. Some of the consequences of these dangerous substances can cause skin burns, skin cancer, shortness of breath, lung cancer and even death.

Work accidents that often occur are caused by human error. Still, it is also necessary to anticipate correctly and carefully the use and layout of tools or materials that can cause accidents or what is commonly known as HAZMAT.

Personnel can be anticipation efforts can be started by identifying the causes of accidents to determine what deserves attention for later repairs. In designing repairs, it is also necessary to do a financial analysis of the costs incurred for these repairs and the benefits that can be obtained from the implementation of these improvements so that later we will get the results of repairs as well as reduce the risk of work accidents and the design is feasible to implement in the company concerned (Squadron 900 / Fasharkan)

2. LITERATURE REVIEW

2.1 K3

The definition of occupational health and safety, safety is related to the acute effect of a hazard, while health is related to the chronic result of a Hazard (Ashfal, 1999)

Work accidents consist of categories ranging from minor work accidents to work accidents that can have fatal consequences (causing death). The following are some types of work accidents based on the Safety Report (2005):

a. Fatality

Work accidents that cause death.

b. Lost Time Injury

Work accidents- interfere with the health of workers, so they cannot carry out work activities.

c. Restricted Work Day Case

Work accidents disrupt the health of workers so that the work performance given is not optimal.

d. Medical Treatment Case

Work accidents that can handle by medical personnel only.

e. First Aid Case

Work accidents with consequences that can overcome with first aid in work accidents can not only- done by medical personnel.

f. Near Miss Incident

Work accidents with minimal consequences on human, material, environmental and media aspects.

g. Anomaly

Conditions or actions that are unsafe and may result in accidents.

Hammer (1989) defines Hazard as a potential condition to cause injury to personnel, damage to equipment or building structures, loss of material or reduced ability to perform a predetermined function. Hazard can also- define as the characteristics of materials, conditions or potentially detrimental to property, humans and the environment (ICF Consulting, 2000).

Following are some of the Hazard categories in the Industry:

a. Physical Hazards

Noise, radiation, lighting, heat.

b. Chemical Hazards

Hazardous and toxic materials, dusts, chemical fumes, chemical solutions.

c. Biological Hazards

Viruses, Bacteria, Fungi, Parasites.

d. Mechanical Hazards

Machinery, equipment.

e. Ergonomic Hazards

Narrow and limited space, lifting goods, pushing, pulling, inadequate lighting, little body movement.

f. Psychosocial Dangers

Work shift patterns, work organization, long working hours, trauma.

g. Behavioral Hazards

Non-compliance with standards, lack of skills, new or irregular assignments.

h. Environmental Hazards

Dark, uneven surfaces, slopes, muddy and wet surface conditions, weather, fire.

According to the US Department of Transportation (1998), the classification of hazardous materials is explosive, gas (flammable/nonflammable), flammable liquids (flammable liquids), oxidizers, radioactive materials, corrosives, poison (poisons from corroded equipment). Infectious substances (dispersible elements) and miscellaneous materials. The following is an explanation of some of these hazardous materials (Hammer, 1989):

a. Fuel is an element that acts as a "reducing agent" giving electrons to the oxidizer in a chemical combination. Examples of Fuel include carbon, hydrogen, magnesium, methane, rubber, and so on.

b. oxidizer is an element that gets electrons from Fuel in a chemical reaction. Examples are oxygen, chlorine, halogens, nitrates, nitrites, peroxide and several other strong acids such as sulfuric, hydrochloric, etc. This oxidizer must be handled carefully to prevent contact with the Fuel.

c. Flammable Material (flammable materials) consists of Fuel for heating, internal combustion engines, welds, rocket engines, solvents and cleaning agents, lubricants, paints, varnishes, coolants, plastics and polymers, rubber, metal materials (sodium, potassium, cesium, rubidium, metal dust, powders, fibres, ribbons).

d. Both flammable and non- flammable materials, the air is not volatile. Still, it will burn when it reacts with a strong oxidizer, high oxygen concentration, very high temperature or ignition material. Examples are halogenated hydrocarbons, soaps and silicone rubbers, plastics and polymers, metals in solid form, mixtures of lubricants with hydraulic fluids.

e. Gases. There are limits and ranges of gas levels in the air to stay in safe conditions.

f. Flammable and Combustible are Liquids. It is a flammable liquid but previously changed its phase to free gas.

2.2 Risk Management System

Risk Management is applying a process of mathematical assessment and supervision of policies, practices and resources that can affect human health, safety, and the environment (USDOT, 1989). According to the European Union (1999), risk management is a formal process for managing risks. The process consists of system definition, hazard identification, identification of accident scenarios, quantification of the probability and consequences of risk assessment, identification of a risk control system, a decision to go to the stage implementation, and slip and management of the residual risks that exist.

a. Options Generation.

Identification of alternative options available for decision- making, identifying factors that may influence the decision, and risk factors.

b. Select Methods / Tools.

It is choosing the correct - method or tools for analyzing decision making. Usually by using benefit-cost analysis.

c. Analyze / Evaluate.

Perform a specific analysis, including benefit-cost and comparison of existing options.

d. Select Options.

Select and recommend alternative approaches for the implementation of risk management strategies and measures.

e. Identify Residue Risks.

Identify the risks that will occur and make ways to handle them.

2.3 FMEA

Kmenta (2002) cites Omdahl (1998) defines Failure Modes and Effect Analysis as a technique used to identify, prioritize, eliminate the possibility of system, design or process failures before reaching the customer. Furthermore, Hammer (1989) explains that FMEA is used to determine how long - equipment can operate correctly - and determine what effects the failure of the equipment component will produce.

The steps of the FMEA are as follows:

a. Define the system.

Defining a system of a process or product, and identifying its components, by creating a modelling system can be a block diagram or a fault tree diagram.

b. Identify Potential failure modes and their causes, identify the possibility of failure, along with the effects that will cause.

c. Evaluate the effect on the system of each failure mode. The consequences of possible failure can identify using the Severity Index, which indicates the seriousness of the impact due to the type of failure. Some of the commonly used classifications include four levels, namely 1 Catastrophic, 2 Critical, 3 Major, 4 Minor.

d. Identify failure detection methods / corrective actions, identify strategies for detecting failures and identify the presence of disciplinary actions, for example, alarms, inspection activities. These things need- to correct failures and provide a backup system to reduce breeding risk in the existing system.

2.4 NPV

Dharsono (2007) cites Joesron (2001) defines NPV as the value of the project in question, which is obtained based on the difference between the resulting cash flow and the investment issued. A proper NPV is a positive NPV, where the cash flow generated exceeds the amount invested.

NPV calculation is by discounting all cash inflows and outflows during the project life (investment) to present value, then calculating the difference between the present value of the inflows and outflows. NPV shows the lump sum amount, which with a specific discount flow (WACC) gives a figure of how much the current business value (IDR) is (Gunarta, 2006). If it is written with the equation, it will be:

$$NPV = \sum_{t=0}^{n} \frac{(C)t}{(1+i)^t} - \sum_{t=0}^{n} \frac{(Co)t}{(1+i)^t}$$

Where,

NPV = Net Present Value

(C) t = Cash inflow in year t

(Co) t = Cash Outflow in year t

n = The age of the investment yield business unit

i = Flow of Return (rate of return)

t = Time

3. RESEARCH METHODS

This research is conduct in four stages: the preliminary stage, data collection, data processing, analysis and finally, the Conclusion and Suggestion Stage. Shown in the flow chart as follows:

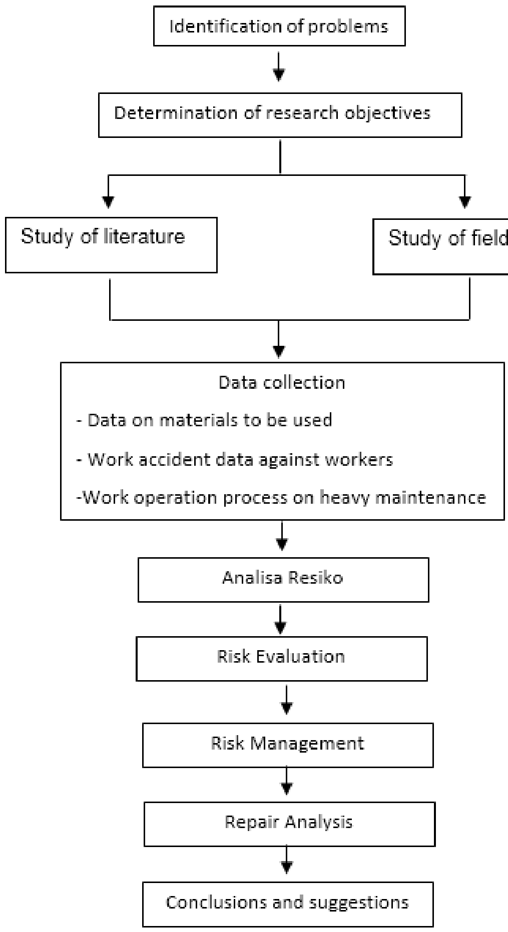


Figure 3.1 Flow Chart of Research Methods

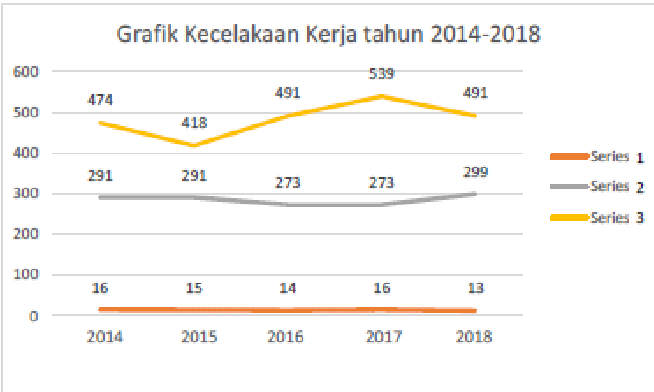
The preliminary stage consists of problem identification, research objective setting, literature study, field study. At the data collection stage, namely, data that supports the data processing process. In the data processing stage, steps are carried out for risk analysis, risk evaluation and risk management. In the Analysis Phase, an investigation is carried out from the results of the improvement efforts that have been made. In the conclusions and suggestions stage, conclusions are drawn from the research that has been carried out as well as suggestions for further research that are related to this research.

4. RESULT AND DISCUSSIONS

Table 4.1 data on occupational accidents for 2014-2018

From the tables and graphs, it can be seen that a large number of squadron 900/ fasharkan who suffer from health problems due to work accidents is almost the same every year if you take the monthly average it is found that respiratory diseases and skin diseases get pretty high scores, namely 40 and 24. Mean while other condition such as fractures and mus**cle pain scored a puny average of 1 per month**

Other diseases (fractures,muscle pain,etc)						Skin irritation						Respiratory diseases					
Month	Year					Month	Year					Month	Year				
	2014	2015	2016	2017	2018		2014	2015	2016	2017	2018		2014	2015	2016	2017	2018
1	3	2	2	2	2	1	38	25	24	25	22	1	51	41	29	55	58
2	0	2	1	0	2	2	27	15	17	35	25	2	34	53	36	54	65
3	4	0	0	2	1	3	21	29	15	16	12	3	42	26	32	53	41
4	2	0	3	0	1	4	17	14	23	19	34	4	37	23	43	48	42
5	0	0	1	0	3	5	30	27	26	24	21	5	43	41	52	54	36
6	3	0	0	2	0	6	17	34	27	22	16	6	51	48	69	59	34
7	0	4	2	3	1	7	12	15	22	24	31	7	52	40	44	47	48
8	2	1	2	0	0	8	15	26	19	29	41	8	43	42	27	32	13
9	0	2	1	2	1	9	18	28	24	18	25	9	32	32	30	21	34
10	1	0	0	1	1	10	23	25	22	17	21	10	26	30	53	45	27
11	0	0	1	3	1	11	36	39	23	20	32	11	28	19	45	36	39
12	1	4	1	1	0	12	37	13	31	24	19	12	35	23	31	35	54
total	16	15	14	16	13	total	291	290	273	273	299	total	474	418	491	539	491
average per year			14,8=15			average per year			285,2=285			average per year			482,6=483		
averageper month			1,23=1			average per month			23,78=24			average per month			40,22=40		



Work acccident in 2014 - 2018

From the tables and graphs, it can be seen that a large number of squadron 900/ fasharkan who suffer from health problems due to work accidents is almost the same every year if you take the monthly average it is found that respiratory diseases and skin diseases get pretty high scores, namely 40 and 24. Mean while other condition such as fractures and muscle pain scored a puny average of 1 per month.

Hazard identification in the frame division using FMEA can be displayed in the table as follows:

Table 4.2 FMEA in the Order Division

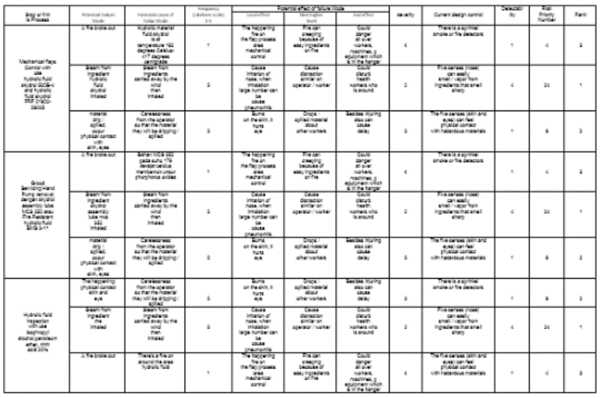
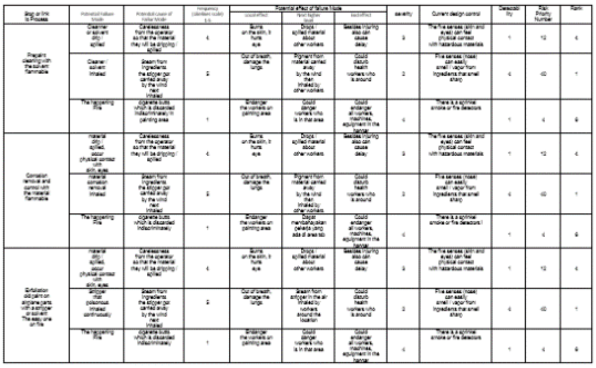


Table 4.3 FMEA in the Mechanical Division



Tabel 4.4 Recap of potential Hazard in the Frame Division

Rank	Types of potential hazards in the Mechanical Division
1	Hazardous materials
2	Steam from paint during the painting process
3	Paint material during the mixing process
4	The occurrence of physical contact with hazardous materials
5	The occurrence of physical contact with the paint material during the mixing process
6	There was a fire
7	The occurrence of physical contact with the paint material during the painting process

Table 4.5 Recap of potential hazards in the Mechanical Division

Level	Likelihood Class	Incident
A	Frequent	Probability (≥ 17 failures per month)
B	Probable	Often occurs ($11 \leq x \leq 16$ failures per month)
C	Occasional	Occurs multiple times ($5 \leq x \leq 10$ failures per month)
D	Remote	Occurs Occasionally ($2 \leq x \leq 4$ failures per month)
E	Very Unlikely	Very rare chance (≤ 1 failure per month)

Table 4.6 Occurance (O) Evaluation of Criteria

Rank	Types of potential hazards in the Order Division
1	Inhalation of steam from Hydrolic fluid skydrol
2	The occurrence of physical contact of hazardous substances on the skin, eyes or into the mouth
3	The occurrence of fire

Table 4.7 Occurance (O) Evaluation of Criteria for each type of failure

No	Type of Failure	Likelihood Class
1	Inhalation of dangerous chemicals enter the respiratory tract	Frequent
2	Physical contact with hazardous chemicals	Probable
3	Fire	Veru Unlikely

Table 4.8 Severity (S) Evaluation of criteria

Level	Severity Class	Information
I	Catastrophic	Accidents that cause fatal injury or death of workers / operators
II	Critical	Accidents that cause an injury that does not result in death
III	Mayor	Low level accidents on operators / workers
IV	Minor	Damage to the system or environment but does not affect workers /operators

Table 4.9 Severity (S) Evaluation of criteria for each type of failure

No.	Type of Failure	Severity Class
1	Inhalation of dangerous chemicals enter the respiratory tract	Major
2	Physical contact with hazardous chemicals	Critical
3	Fire	Catastrophic

From the results of categorizing the occurrence and severity of each failure, a matrix will be made to determine the position of the type of failure and to find out what steps to take next.

Table 4.10 Risk Matrix

Likelihood / Occurance	Severity			
	Minor	Major	Critical	Catastrophic
A (Frequent)		1		
B (Probable)			2	
C (Occasional)				
D (Remote)				
E (Very Unlikely)				3

Information :

= Unacceptable (must be mitigated to a lower level)

= Undesirable

= Acceptable with control

= Acceptable as is, the risk is acceptable, no need to take action.

Process activities in the frame division generally use relatively few hazardous materials compared to the Mechanical Division so that they are not so dangerous to personnel outside the frame division. Still, overall, the process of activities in the Frame Division and the Mechanical Division can be hazardous. Personnel in the hangar room. Its surroundings, so there is a need for an alternative solution to cover it all.

The alternative solutions offered for this problem:

1. Do Nothing
2. Renovation of the painting room
3. Development of a particular painting room

3 Alternative explanations for this type of risk 1. For type 2 risk, there are two alternative solutions, first Do nothing and the second is to impose sanctions and the installation of a safety sign. As for the type of risk 3, the alternative solutions are Do nothing and Safety equipment and Safety sign.

NPV calculation Alternative solutions to the risk of inhalation of vapours from hazardous materials shown using the following table:

Solution 1 for Risk 1	
Cost of Lost Working Days	
Wages / day	Rp. 45.000,00
Amount average Work accident / year	483
Lost work day / accident	1
Cost of lost working days / year = wages / day X average amount Work accident / year X days lost work / accident	Rp. 21.735.000,00
Overtime cost personel	
Overtime pay / day	Rp. 125.000,00
Average Overtime days	104
amount of Overtime personel	7
Overtime expenses / year = overtime pay / day X average overtime / year X amount of personnel overtime	Rp. 91.000.000,00

Solution 2 for Risk 1	
Cost Savings on lost work days	
Percentage of savings / year	80%
Total savings in loss working day/year	Rp. 17.388.000,00
Cost Savings in personnel overtime	
overtime cost savings personnel / year = overtime costs personel/year	Rp. 91.000.000,00
Renovation Costs	
Purchase and installation costs pvc partition curtain	Rp. 30.000.000,00
Sewer construction costs	Rp. 55.000.000,00
Cost of manufacture / m	Rp.100.000,00
Circumference of channel in hangar (m)	544
Go around the channel in the painting room	6
Total cost of renovation	Rp.85.000.000,00
Maintenance costs I	
Estimated cost of treatment / month	Rp. 200.000,00
Maintenance costs / year	Rp. 2.400.000,00
Cost of Lost Working Days	
Percentage of lost work days	20%
Cost of lost working days / year	Rp. 4.347.000,00

Solution 3 for Risk 1	
Cost Savings on lost work days	
Percentage of savings / year	95%
Total savings in loss working day/year	Rp. 20.648.250,00
Cost Savings in personnel overtime	
overtime cost savings personnel / year = overtime costs personel/year	Rp. 91.000.000,00
Development Costs	
Development Costs	RP. 430.289.484,00
Equipment Costs	Rp. 50.000.000,00
Total Development costs	Rp.480.289.484,00
Maintenance costs II	
Estimated cost of treatment / month	Rp. 1.000.000,00
Maintenance costs / year	Rp. 12.000.000,00
Cost of Lost Working Days	
Percentage of lost work days	5%
Cost of lost working days / year	Rp. 1.086.750,00

Solution 1 for Risk 1

year	0	1	2	3	4	5
Cash In						
Cash Out	112.735.000	112.735.000	112.735.000	112.735.000	112.735.000	112.735.000
Cash Flow	-112.735.000	-112.735.000	-112.735.000	-112.735.000	-112.735.000	-112.735.000
NPV	-568.847.834					

Solution 2 for Risk 1

year	0	1	2	3	4	5
Cash In	108.388.000	108.388.000	108.388.000	108.388.000	108.388.000	108.388.000
Cash Out	89.347.000	6.747.000	6.747.000	6.747.000	6.747.000	6.747.000
Cash Flow	19.041.000	101.641.000	101.641.000	101.641.000	101.641.000	101.641.000
NPV	430.268.787					

Solution 3 for Risk 1

year	0	1	2	3	4	5
Cash In	111.648.250	111.648.250	111.648.250	111.648.250	111.648.250	111.648.250
Cash Out	493.376.234	13.086.750	13.086.750	13.086.750	13.086.750	13.086.750
Cash Flow	-381.727.984	98.561.000	98.561.000	98.561.000	98.561.000	98.561.000
NPV	17.040.501					

Solution 1 for Risk 2	
Cost of Lost Working Days	
Wages / day	Rp. 45.000,00
Amount average Work accident / year	285
Lost work day / accident	2
Cost of lost working days / year = wages / day X average amount Work accident / year X days lost work / accident	Rp. 25.650.000,00

Solution 2 for Risk 2		
Cost Savings on lost work days		
Period	Percentage savings	Savings in lost costs Working hours
year 0	98%	Rp. 25.137.000,00
year 1	100%	Rp. 25.650.000,00
year 2	100%	Rp. 25.650.000,00
year 3	100%	Rp. 25.650.000,00
year 4	100%	Rp. 25.650.000,00
year 5	100%	Rp. 25.650.000,00
Purchase Costs Safety Sign		
Price / Safety Sign		100000
amount Safety Sign		8
Biaya Pembelian		Rp. 800.000,00
Costs Lost hours of work		
Period	Percentage savings	Savings in lost costs Working hours
year 0	2%	Rp. 530.000,00
year 1	0%	Rp.0
year 2	0%	Rp.0
year 3	0%	Rp.0
year 4	0%	Rp.0
year 5	0%	Rp.0

Solution 1 for Risk 2

year	0	1	2	3	4	5
Cash In						
Cash Out	25.650.000	25.650.000	25.650.000	25.650.000	25.650.000	25.650.000
Cash Flow	-25.650.000	-25.650.000	-25.650.000	-25.650.000	-25.650.000	-25.650.000
NPV	- 129.426.948					

Solution 2 for Risk 2

year	0	1	2	3	4	5
Cash In	25.137.000	25.650.000	25.650.000	25.650.000	25.650.000	25.650.000
Cash Out	1.313.000	0	0	0	0	0
Cash Flow	23.824.000	25.650.000	25.650.000	25.650.000	25.650.000	25.650.000
NPV	127.600.948					

Solution 1 for Risk 3	
Cost of Lost Working Days	
Wages / day	Rp. 45.000,00
Amount average Work accident / year	250
Lost work day / accident	63
Estimated working days lost	13
Cost of lost working days / year = wages / day X average amount Work accident / year X days lost work / accident	Rp. 35.437.500,00

Solution 2 for Risk 3	
Cost Savings on lost work days	
Wages / day	Rp. 45.000,00
Working day/year	250
amount labor	63
Non-lost work day / year 3% X work day/year	8
Cost savings lost work day /year = wages/day X amount labor X day work is not lost	Rp. 21.262.500,00
Purchasing costs Safety Equipment	
amount Safety Cabinet	2
price/Safety Cabinet	Rp. 800.000,00
amount Safety cans	7
price/Safety Cans	Rp. 456.000,00
purchasting costs Safety Equipment	
purchasing costs Safety Sign	
price/Safety Sign	Rp. 100.000,00
amount Safety Sign	8
purchase costs	Rp. 800.000,00
Cost of Lost Working Days	
Wages / day	Rp. 45.000,00
Working day/year	250
amount workforce	63
Non-lost work day / year 3% X work day/year	5
Cost savings lost work day /year = wages/day X amount labor X day work is not lost	Rp. 14.175.000,00

Solution 1 for Risk 3						
year	0	1	2	3	4	5
Cash In						
Cash Out	35.437.500	35.437.500	35.437.500	35.437.500	35.437.500	35.437.500
Cash Flow	-35.437.500	-35.437.500	-35.437.500	-35.437.500	-35.437.500	-35.437.500
NPV	-178.813.546					

Solution 2 for Risk 3						
year	0	1	2	3	4	5
Cash In	21.262.500	21.262.500	21.262.500	21.262.500	21.262.500	21.262.500
Cash Out	19.767.000	14.175.000	14.175.000	14.175.000	14.175.000	14.175.000
Cash Flow	1.495.500	7.087.500	7.087.500	7.087.500	7.087.500	7.087.500
NPV	30.170.709					

5. CONCLUSIONS

From the research that has done, the following conclusions can draw:

a. Most of the causes of work accident hazards in the 900 / Fasharkan squadron are jobs that use hazardous materials, which are generally flammable, toxic and can cause irritation.

b. The risks arising from the use of hazardous materials include: Burns or skin irritation, disruption of the respiratory tract, digestive system, and brain (memory) system and can also cause a fire.

c. The frequency of probability of work accidents varies, depending on the conditions, time, and type of work carried out in each activity process.

d. The risk of danger with the highest ranking in the skeleton division is the risk of inhalation of vapours from hazardous materials, followed by the threat of physical body contact with hazardous materials and the risk of fire. Whereas in the Mechanical division, the risks that are ranked 1-3 are the risk of inhalation of vapours and hazardous materials, then ranking 4-5 is the risk of physical contact with the body with hazardous materials, and the 6th position is the occurrence of fire

e. To reduce the risk 1, 3 alternative solutions designed, namely:

1) Do nothing
2) Renovation of hangars and halls painting
3) Development special room painting

To reduce the risk of 2, two alternative solutions designed, namely:

1) Do nothing
2) Giving sanctions and using a safety sign

To reduce the risk of 3, the design of 2 alternative solutions, namely:

1) Do nothing
2) Use of safety equipment and safety sign

f. To reduce the risk 1, the second-best alternative solution chosen, to minimize the risk 2, the second-best alternative solution is chosen, and to reduce the risk 3 the second-best alternative solution is chosen

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STRATEGY OF ACCELERATE THE APPLICATION BIODIESEL IN KRI KOARMADA II TO INCREASE ALUTSISTA COMBAT READINESS

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ABSTRACT

Through Presidential Regulation No. 5 of 2006 on National energy policy and Esdm Ministerial Regulation No.32 of 2008, the Government encourages the use of biodiesel in all aspects. In KRI, the use of biodiesel is only for KRI with machines that are still conventional or have not used a common rail system. Until 2020 KRI that has migrated to biodiesel is 32.5% of 40 KRI. Switching to biodiesel is not an easy matter, this is due to the complexity of the problems in KRI, both in terms of the limited budget, material components that do not support biodiesel, maintenance, and operations. Therefore, the writing of this journal aims to formulate a strategy to accelerate the application of biodiesel in KRI in Koarmada II by using the TOWS method (Threats, Opportunities, Weakness, Strength). The results of the analysis based on TOWS analysis obtained quadrant strategy is in quadrant III which is a Turn-around strategy that means making a strategy by suppressing weaknesses by utilizing existing opportunities. The development of the strategy resulted in 7 relevant sub-strategies to be used as an effort to accelerate the application of biodiesel to KRI in the Koarmada II.

Keywords: Renewable energy, Biodiesel, KRI, TOWS.

1. INTRODUCTION

In the third quarter of 2018, the Goverment expanded the policy of using Biodiesel 20 not only for public Service obligation (PSO) but expanded to non-PSO which covering heavy equipment, industry, and shipping. Biodiesel or Fatty Acid Methyl Ester (FAME) is a fuel produced from vegetable oils or animal fats, through a chemical process called transesterification. Biodiesel with a percentage of 0-100%, through little or no modification to the engine. The term B20 means fuel which is a mixture of 20% FAME and 80% HSD.

The government's policy encouraged the Navy to adjust and migrate from hsd to biodiesel. In general, the application of biodiesel in KRI requires adjustment of materials (pipes, plates, hoses, seals, gaskets, etc.) that support biodiesel and the need for fuel treatment before entering the combustion chamber. However, due to the variety of technology in the engine used by KRI, and the characteristics of biodiesel and taking into account all aspects, performance, maintenance, and durability in the use of biodiesel, the application of biodiesel is intended for ships with engines that are still conventional in terms of combustion technology, while ships with engines that are already based on common rail and turbines still use Hsd (Slogal, 2020, P.6).

KRI owned by koarmada II is 65 KRI, while the eligible in the use of biodiesel amount of 40 KRI (Slog Koarmada II, 2021). Until 2020, KRI that has migrated to biodiesel reaches 13 KRI (Disbeka, 2020, P.1). It means that those who have migrated to biodiesel are 32.5%, while 67.5% still have not switched to biodiesel.

Table 1. KRI Koarmda II that already uses Biodiesel

NO	KRI
1	YOS-353
2	OWA-354
3	AHP-355
4	KST-356
5	USP-372

6	LAM-374
7	HIU-634
8	AJK-653
9	PDG-801
10	TKL-813
11	SKU-842
12	KKP-811
13	BDU-841

Source : Disbekal, 2020

On another occasion, President Joko widodo (2018) affirmed:

"The use of B20 Biodiesel must be forced and there is no bargaining anymore because it concerns a big and important issue, namely trade balance, foreign exchange needs, and savings".

So that with the mandate directly by the President that is strengthened by the regulation of the Minister of Energy and Mineral Resources No. 32 of 2018 on the Provision, Utilization and Commercial Governance of Biofuels as Other Fuels, then as an effort to accelerate the use of biodiesel in KRI, a special strategy is needed.

The writing of this journal aims to formulate a special strategy taken in accelerating the application of biodiesel on KRI to improve the combat readiness of Alutsista faced with existing problems. Pointing out the above problems, the author tries to create a strategy using the TOWS approach (Threats, Opportunities, Weaknesses, Strengths,).

2. MATERIAL / METHODOLOGY

2.1. Indonesian Biodiesel Policy

Through Presidential Regulation No. 5 of 2006 on National energy policy and Regulation of the Minister of Energy and Mineral Resources No.32 of 2008 on the Provision, Utilization and Commercial Administration of Biofuels as another fuel, the government strives to develop renewable energy that can meet the needs of the community cheaply and affordably.

Basically, biodiesel usage policy has 5 main objectives (Dirjen EBTKE, 2018, P.1) including: 1) Supporting national energy security; 2) Support domestic economic growth; 3) Reduce greenhouse gas emissions and improve environmental quality; 4) Increase economic added value; 5) Reduce the consumption of imports and fossil fuels.

The government targets until 2025, biodiesel usage should reach 30%. Here's the table of the mandatory phasing of vegetable fuel utilization

Tabel 2. Mandatory utilization of Biofuels

SEKTOR	2015	2016	2020	2025
Transportation, and Public Services (PSO)	15 %	20%	30%	30%
Transportation, and NON-PSO	15 %	20%	30%	30%
Industrial and Commercial	15 %	20%	30%	30%
Power plant	25%	30%	30%	30%

Source : Minister of ESDM, 2018.

2.2. Characteristics of Biodiesel

According to (Slogal, 2020) biodiesel characteristics (FAME) that need to be known are: 1) solvent; 2) Hygroscopic; 3) Easily contaminated microbes; 4) Reactive to bronze, copper, lead, lead, zinc, and seal/gasket materials made of Nitrile Rubber Compound, Polypropylene, and Polyvinyl.

While some types of Alutsista KRI / Alpung are not allowed to use B+ (according to the relaxation criteria of the Ministry of Energy and Mineral Resources) namely:

a. That uses a common rail system;
b. That uses gas turbines;
c. Submarines;
d. Aircraft; and.

e. Has fuel specification requirements that are not the same as biodiesel specifications issued by the Ministry of Energy and Mineral Resources.

2.3. Biodiesel Studies

Before the implementation of B20 in 2014 and 2015 the Ministry of Energy and Mineral Resources (EBTKE, LEMIGAS), GAIKINDO, APROBI, BPPT, BPDS, PERTAMINA, and ITB conducted an assessment of the durability of diesel vehicles (Toyota, Mitsubishi Hino, Ford, and Chevrolet) up to 40,000 km. The final result in general is very satisfactory and the biodiesel program can be continued. This is also reinforced by JAMA's statement that allows the mixing of biodiesel in fuel not exceeding 20%.

In addition to cars, the Ministry of Energy and Mineral Resources also conducted performance tests on EMD CC205 and GE CC206 trains for 6 months with the result that the train could still reach maximum power and lower exhaust emissions.

2.4. TOWS Theory

TOWS analysis is a process that requires management to think critically about its operations. TOWS analysis is an analysis that prioritizes studying and investigating the opportunities of external factors because it is considered more dynamic and competitive, after which it continues to analyze internal factors. By identifying multiple action plans that can improve the position of the organization's objectives, TOWS analysis allows management to select some of the most effective strategies and take advantage of available opportunities.

TOWS analysis shows the right strategy in four categories (TW, TS, OW, OS). Threat-Weakness (TW), this strategy identifies threats to correct existing weaknesses. Threat-Strength (TS), this strategy identifies threats to develop a strength strategy. The Opportunity-Weakness (OW) strategy is used to identify opportunities to correct weaknesses. Finally, the Opportunity-Strength (OS) strategy is used to identify opportunities to develop strength strategies.

2.5. Differences between TOWS and SWOT

SWOT analysis and TOWS analysis are two analyses that have different analytical focuses. Here's the focus difference between SWOT and TOWS analysis:

a. SWOT analysis emphasizes more on internal condition and situation factors, namely strengths and weaknesses of yourself or company (SW). After that just studied and taken into account external factors, threats, and opportunities (OT).

b. TOWS analysis first studied and investigated several external factors, because it is considered more dynamic based on external factors, namely opportunities and threats (OT). After obtaining external information, then made some adjustments to the improvement of internal potential strengths and weaknesses of the organization (SW).

In the context of the Strategy to Accelerate the Application of Biodiesel In KRI Koarmada II To Improve Alutsista Combat Readiness, the TOWS analysis will be more appropriate and precise. The preparation of the strategy requires an investigation in advance related to external factors, namely current opportunities, and threats (O-T). Furthermore, based on the identification of external aspects, it can be continued evaluation and preparation of the needs of internal factors, namely strengths and weaknesses (S-W) following the vision, mission, and goals achieved, namely the use of biodiesel in KRI.

Table 3. Matrik TOWS

EKSTERNAL/INTERNAL FAKTOR	WEAKNESS (W)	STRENGTHS (S)
	Negative internal aspects can be controlled and can be improved in planning.	Positive internal aspects can be controlled and can be strengthened in planning.
THREATS (T)	**STRATEGY (T-W)**	**STRATEGY (T-S)**
Negative external conditions that cannot be controlled and may be minimized in impact.	Identify threats to correct weaknesses	Identify threats to develop a strategy of strength
OPPORTUNITY (O)	**STRATEGY (O-W)**	**STRATEGY (O-S)**
Positive external conditions that cannot be controlled and can be taken advantage of.	Identify opportunities to correct weaknesses	Identify opportunities to strategize strengths

2.6. Research Methodology

This research is conducted in four stages, namely the preliminary stage, data collection, data processing, analysis and the last is the conclusion and suggestion stage. Shown in the flow chart as follows:

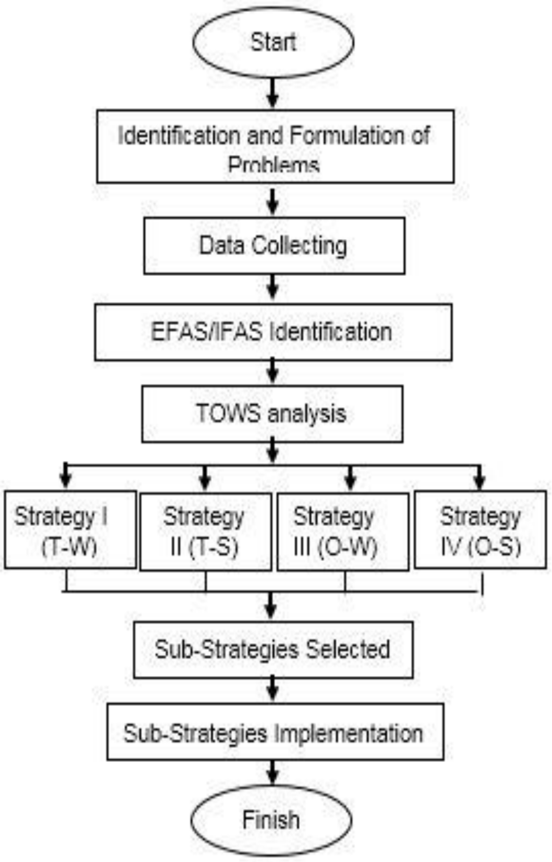

Figure 1. Flow Chart Research Method

The preliminary stage consists of the identification of the problem, the determination of goals. The stage of data collection is carried out through interviews and library studies to determine the EFAS and IFAS factors. At the stage of data processing is carried out matrix calculation steps by giving weight value and rating first. At the stage of data analysis is carried out an analysis of the calculation that has been contained in the quadrant will be used as an option of the strategy. At the conclusion stage, conclusions were drawn from the research that has been done as well as suggestions for further research related to this research.

3. RESULT AND DISCUSSION

Analysis strategy acceleration of biodiesel application in KRI to improve the readiness of combat Alutsista using TOWS (threats, opportunity, weaknesses, strengths) is by minimizing weaknesses and threats while maximizing strength and opportunity.

EFAS and IFAS factors that will be used as the basis in calculating weight, rating, and score, can be described as follows:

a. Opportunity and threat factors as external factors (EFAS)

1) Threat factors:
   a) Limited HSD depots in the area of operation
   b) The nature or character of biodiesel that is reactive to some materials
   c) Potential damage to engine components due to biodiesel use.
2) Opportunity factors :
   a) Biodiesel is a renewable alternative energy
   b) Some engine makers allow the use of biodiesel
   c) Biodiesel depots are already many outside the base

b. Strength and weakness factors as internal factors (IFAS)

1) Weakness factors :
   a) Periodic filter replacement and maintenance will be faster.
   b) Potential blockage of the fuel injection system.
   c) Biodiesel is abrasive to some materials or components
   d) the amount of KRI owned by Koarmada II is quite a lot.
2) Strength factors :
   a) Conventional engine technology is easier in the application of biodiesel.
   b) Aslog KSAL policy in the use of biodiesel in the NAVY
   c) Professional human resources 3rd
   d) Some advantages of biodiesel that HSD does not have.

The next step is to carry out weighting against internal and external factors, the value weight is obtained using data retrieval by experts in the Navy concerning biodiesel. The results of weighting against TOWS factors are as follows:

Table 4. Threat Factors

Threat factor	Weight	Rating	Weight x Rating
Limited HSD depots in the area of operation	0,28	3	0,84
The nature or character of biodiesel that is reactive to some materials	0,36	2,4	0,864
Potential damage to engine components due to biodiesel use.	0,36	3,4	1,224
			2,928

Table 5. Opportunities Factors

Opportunities Factors	Weight	Rating	Weight x Rating
Biodiesel is a renewable alternative energy	0,44	2,4	1,056
Some engine makers allow the use of biodiesel	0,36	3,4	1,224
Biodiesel depots are already many outside the base	0,2	3,6	0,72
			3

Table 6. Weakness Factors

Weakness Factors	Weight	Rating	Weight x Rating
Periodic filter replacement and maintenance will	0,3	3,4	1,02

be faster.			
Aslog KSAL policy in the use of biodiesel in the NAVY	0,225	2,4	0,54
Biodiesel is abrasive to some materials or components	0,25	2,8	0,7
the amount of KRI owned by Koarmada II is quite a lot.	0,225	2,6	0,585
TOTAL	**1**	**-**	**2,845**

Table 7. Strenght Factors

Strenght Factor	Weight	Rating	Weight x Rating
Conventional engine technology is easier in the application of biodiesel.	0,325	3,2	1,04
Aslog KSAL policy in the use of biodiesel in the NAVY	0,3	2,8	0,84
Professional human resources 3rd	0,225	3	0,675
Some advantages of biodiesel that HSD does not have.	0,15	1,6	0,24
TOTAL	**1**	**-**	**2,795**

Table 8. Qudrant calculation

Eksternal (Y)	**Value**	**Internal (X)**	**Value**
Opportunities	3	*Strengths*	2,795
Threats	2,928	*Weakness*	2,845
Value Y	0,072	**Value X**	-0,05

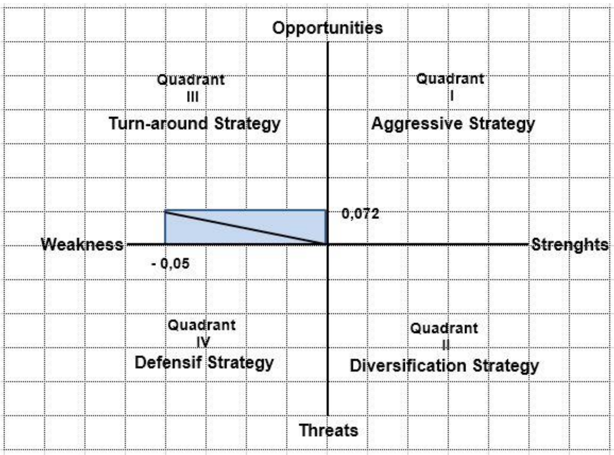

Figure 2. TOWS Diagram

Based on the calculation results and quadrants of TOWS above can be seen that the right strategy is in quadrant III which is a Turn-around strategy which means to reduce weakness by utilizing opportunities to develop a strategy.

So to accelerate the application of biodiesel in KRI to improve the combat readiness of alutsista in Koarmada II, special strategies are needed including:

a. Refocusing of budget for accelerated biodiesel application on ships with conventional engines (W4, O2).

b. Calculation of the need for replacement materials (W4, O3)

c. Replacement of reactive material to biodiesel (W3, O1).

d. Modification of the fuel system onboard (W1, O1).

e. Education standard operating procedure (SOP) use of biodiesel to crew (W4, O1).

f. Procurement of more filters and accelerate periodic filter replacement (W1, O2).

g. Periodic evaluation (W1, W2, O2).

To realize the above 7 (seven) sub-strategies, concrete efforts are needed including:

a. Strategy 1

The application of biodiesel in KRI requires considerable costs, so the need to refocus the budget, through focusing and diverting other KRI maintenance budgets for the implementation of changes to the fuel system. Unless it is urgent, then refocusing does not apply.

b. Strategy 2

Strategy 2 is the calculation of material that needs to be replaced, the effort is to record all equipment or materials to be replaced. As already conveyed by Aslog Ksal, that the characteristics of biodiesel are different from Hsd, so the equipment onboard needs to be adjusted

c. Strategy 3

Biodiesel has a characteristic that is reactive to some materials such as (pipes, plates, hoses, seals, gaskets, etc.), so before application, materials that are reactive need to be replace.

d. Strategy 4

Biodiesel also has more deposits than hsd and has a viscosity that is thicker than hsd, so the need for treatment before use. Treatment is 2 kinds, the first is treatment on the main tank through fuel circulation and the second is the installation of heaters on the fuel pipe before entering the engine, it aims to avoid clumping biodiesel in the fuel capillary pipe and help to occur perfect combustion in the fuel room.

e. Strategy 5

Biodiesel has its character so in its implementation the need for a deep understanding of the character of biodiesel by crews.

f. Strategy 6

In this strategy 6 is the procurement of a lot of fuel filters, this is due to the character of biodiesel that tends to have a lot of deposits. This precipitate will be very dangerous for the machine if filtering is not carried out

g. Strategy 7

Strategy 7 is the conduct of periodic evaluation, this is to know the implications resulting from the use of biodiesel. This evaluation includes filter replacement, engine parameters, performance, maintenance, and damage caused.

4. CONCLUSION

Based on TOWS analysis, it is known that:

a. Known efas weight (external factor) i.e. threat factor is 2,928, while the chance factor is 3.

b. IFAS weight (internal factor) is the weakness factor of 2,845, while the strength factor is 2,795.

c. In quadrant calculation, it is produced in quadrant III, i.e. using the Turn-around strategy.

d. In the processing process, 7 sub-strategies are produced, including:

1) Refocusing of budget for accelerated application of biodiesel on ships with conventional engines.
2) Calculation of the need for replacement materials.
3) Replacement of reactive material to biodiesel.
4) Modification of the fuel system onboard
5) Education sop use of biodiesel to members.
6) Procurement of more filters and speed up periodic filter replacement.
7) Periodic evaluation

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HUMAN RESOURCES DEVELOPMENT STRATEGY IMPROVE PERSONEL PERFORMANCE USING THE SWOT ANALYIS METHOD

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ABSTRACT

In the era of globalization, the development of the security, economic and political situation is very dynamic which is marked by the existence of very open and tight competition. In these conditions an organization is required to be able to make adjustments in various aspects that exist within the organization, especially the organization. This study aims to determine the strategy of developing human resources by analyzing the strengths, weaknesses, opportunities and threats they have. The research method used is the SWOT Matrix Qualitative Method, IFAS Table, EFAS. From the calculation of the IFAS table the strength is lower than the weakness, and the calculation from the EFAS table is greater than the threat so that the diagram point is at point 1 and stability 1. The strategy used is the right strategy that must be applied by the Office of personnel based on SWOT ANALYSIS, namely by applying the SO Strategy (Strength - Opportunities), namely to utilize the strengths of the organization to capture the opportunities of existing organizations.

Keywords: *HR Development Strategy, SWOT Analysis, IFAS, EFAS*

1. INTRODUCTION

In the current era of globalization, the development of the security, economic and political situation in Indonesia is very dynamic along with growth in all fields which are marked by very open and tight competition. In these conditions an organization is required to be able to make adjustments in various aspects that exist within the organization. Limited human resources, requires an organization to optimize the performance of personnel well in order to achieve goals and progress. Therefore, it requires competent human resources who have high morale and discipline in carrying out their roles and functions both for individual and organizational goals. The progress of a country depends on the ability of its human resources.

Recognizing the important role of human resources in their interactions with various factors and parts of the organization, it is necessary to manage human resources as well as possible. This has become a consequence for the institution to make adjustments between HR and these facilities, through training and development in accordance with the conditions and needs of the institution. HR development is a planned and ongoing effort to improve.

Employee competencies and for organizational work through training, education and development programs. There are at least 5 (five) recommended ways or businesses in developing human resources, namely: training, education, coaching programs, recruiting, system changes. The HR development program will be effective if the organization is able to collect and analyze the current conditions, conditions and needs of human resources first. this and in the future, so that development programs that are made really - really lead to success.

It is hoped that this research can help determine a strategy in developing human resources to improve the performance of personnel in the environment In the writing of this journal is also used a lot of literature as a reference to support the research conducted, such as including the following: *Analisis SWOT Bisnis Laundry UD Rafa Laundry Klindocare di Duri Provinsi Riau (Studi Formulasi Strategi Bersaing)* (Khasandra, 2017),

Analisis SWOT sebagai upaya meningkatkan kinerja produksi menuju usaha yang berkelanjutan (Studi pada UKM Batik di Kampung Batik Laweyan Surakarta) (Sugiarti, 2013), *Strategi Pengembangan Sumber Daya Manusia (SDM) Koperasi industri Kakao Sumatra Utara*. Institut Teknologi Indonesia (Tampiko, 2014), *Analisis SWOT untuk menentukan strategi konpeitif pada PD BPR Bank Daerah Lamongan* (Nur Irawan, 2016), *Analisa SWOT untuk mengetahui positioning organisasi dalam memntukan strategi pengembangan sumber daya manusia pada UD Rumekso di Mojokerto (Yon Ismaya, 2017), Perumusan Strategi Organisasi PT X menggunakan Matriks Evaluasi Faktor. Jurnal Sistem Teknik Industri (Ginting, 2016), Analisis Strategi Pemasaran pada Usaha Kecil Menengah (UKM) Makanan Ringan (Studi Penelitian UKM Snack Barokah di Solo) (Zulkarnaen, 2013), Analisis SWOT Teknik Membedah Kasus Bisnis* (Rangkuti, 2005)*, Analisis SWOT dalam penentuan Strategi Bersaing (studi pada PT Bank Syariah Kantor Cabang Syariah Jember)* (Khusnita, 2011)*, Manajemen Sumber Daya Manusia* (Wahyudi., 2011)*, Miftachul Tuwin. 2015. Analisa SWOT untuk Mengetahui Kondisi Sumber Daya Manusia Dalam Rangka Peningkatan Daya Saing Pada CV INDOSAE GPS TRACKER di Surabaya* (Tuwin, 2015)

This research is organized as follows, chapter 1 introduction, chapter 2 shows material and methodology, chapter 3 shows the results of data and discussion, chapter 4 conclusion.

2. MATERIAL/METODOLOGY

2.1 Human Resources

Human Resources are residents who are ready, willing and able to contribute to efforts to achieve organizational goals. In population science, the concept of human resources can be aligned with the concept of labor which includes the workforce and not the workforce. The working force is also called the worker. Organization is basically a collaboration between two or more people in order to achieve a goal. The organization is a collection of people, the process of division of work between these people and the existence of a system of cooperation or social system among these people.

In achieving its objectives, organizations need a variety of resources. Starting from human resources, equipment, machinery, finance, and information resources. Each resource has its own duties and functions. As a system these resources will interact and cooperate with each other so that goals can be achieved effectively and efficiently. Human resource management is very important position for the organization. Therefore, in managing it, managing and utilizing human resources will run as expected. So that it can function productively to achieve organizational goals.

2.2 SWOT analysis

SWOT analysis is the systematic identification of various factors to formulate an organization's strategy. This analysis is based on logic that can maximize strengths and opportunities, but at the same time can minimize weaknesses (weakneses) and threats (threats). The synergy decision-making process is always related to the development of the organization's mission, goals, strategies and policies. Thus strategic planning must analyze the organizational strategy factors (strengths, weaknesses, opportunities, threats).

The SWOT matrix is a tool used to structure factors of organizational strategy. This matrix can clearly illustrate how external opportunities and threats facing an organization are adjusted to their strengths and weaknesses. This matrix can produce four possible alternative cell strategies.

IFAS EFAS	**Strengths (S)** Determine 5-10 internal strength factors	**Weaknesses (W)** Determine 5-10 internal weakness factors
Opportunities (O) Determine external opportunity factors	**SO Strategy** Create a strategy here that uses power to take advantage of opportunities	**WO Strategy** Create a minimizing strategy to utilize
Treats (T) Determine external threat factors	**ST Strategy** Create a strategy here that uses power to overcome threats	**WT Strategy** Create a strategy at minimize weaknesses avoid threats

Figure 1. SWOT Matrix Diagram

Source: Freddy Rangkuti (2009 : 83)

1. SO Strategy

This strategy is made based on the mindset of the organization, namely by utilizing all the power to seize and take advantage of maximum opportunities.

2. ST Strategy

This is a strategy in using the strength of the organization to overcome threats.

3. WO Strategy

This strategy is implemented based on the utilization of existing opportunities by minimizing existing weaknesses.

4. WT Strategy

This strategy is based on activities that are defensive and try to minimize existing weaknesses and avoid threats.

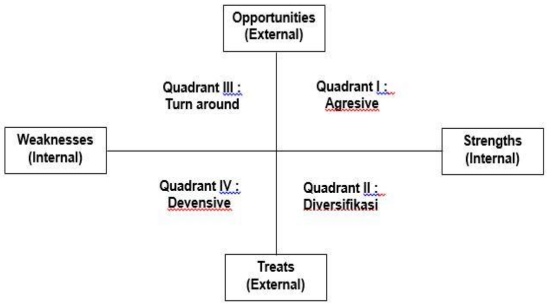


Figure 2. SWOT Analysis Diagram
Source : (Freddy Rangkuti 2009:20)

Information :

Quadrant I:

Is a very favorable situation, the organization has the opportunity and strength of the strategy being implemented that is supporting aggressive growth policies.

Quadrant II:

There is a threat, but it still has internal strength, the strategy being implemented use the power to exploit long-term opportunities by means of a diversification (product / market) strategy.

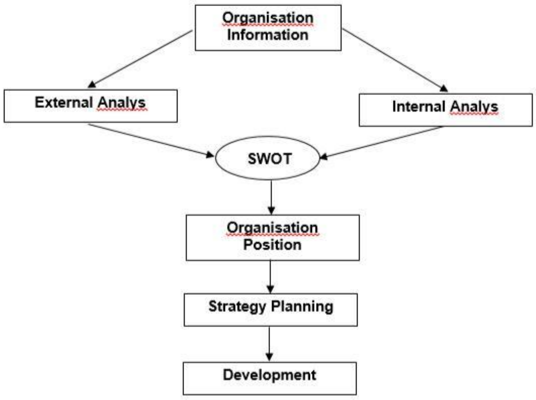
Quadrant III:

O rganizations face enormous market opportunities, but there are some internal obstacles / weaknesses. The strategy must be implemented by minimizing internal problems in order to seize market opportunities.

Quadrant IV:

Is a very unfortunate situation, the company faces various internal threats and weaknesses

Figure 3. Flow of Thought



Research methods

Determination of informants in this study using the Purpose and Snowball sampling methods, namely the determination of samples with certain considerations which were initially small in number, then enlarged according to the need to obtain complete research data. To get information about this organization the authors conducted interviews with relevant officials as Supervisors for initial research the authors only conducted interviews with one informant. Furthermore, from the informants obtained, the writer will conduct further interviews so that information can be explored more deeply so that complete data can be obtained for analysis. Did not rule out the informants in this study will increase again to develop information. In leather research, as stated by Sugiyono (2013), a sample of data sources at the initial stage of entering the field is chosen by people who have the power and authority on the social situation or the object under study, so as to be able to "open the door" wherever researchers will collect data . Who is sampled data sources, and how much can be known after the researcher is finished. So it cannot be prepared from the beginning or in a proposal.

This research was made to determine the position of the organization using SWOT analysis. As a determination of human resource development strategies to improve personnel performance. This type of research, which will be used is descriptive qualitative research. Sugiyono (2011: 15), concluded that the qualitative research method is a research method based on the philosophy of post positivism, used to examine the natural conditions of objects, (as opposed to experiments) where the researcher is a key instrument, the sampling of data sources is done purposively and snowbaal, collecting techniques with triangulation (combined), data analysis is inductive / qualitative, and qualitative research results emphasize more on meaning than generalization.

3. RESULTS AND DISCUSSION.

Strength

a) 1.Quality Personnel performance results
b) 2.Determination of personnel performance standards.
c) Health
d) Dedication
e) Loyalty
f) Organizational Location
g) Discipline

Weaknesses

a) Human Resources
b) Less Creative
c) Personnel Culture
d) Lack of personnel development
e) Lack of regeneration process

Opportunities

a) Have supporting regulations
b) Good and adequate socialization media
c) Technology

d) Organizational Image in the eyes of the community
e) Organizational fulfillment

Threats

a) Number of work accidents
b) Demands for Technology Mastery
c) Government Policy
d) Infectious diseases
e) desertion

The identification of internal and external factors in the organization is as follows:

IFAS Matrix

After the internal strategic factors of an organization are identified, an IFAS (Internal Factor Srategic Analysis Summary) table is compiled to formulate these internal strategic factors within the framework of organizational Strength and Weakness. Determination of the weight based on the influence of factors on the strategic position of the organization, based on the distribution of questionnaires to respondents, namely supervisors, team leaders and personnel, by giving weight to each factor with a scale ranging from 1.0 (most important) to 0.0 (not important), all these weights must not exceed the total score of 1.00. Determination of the rating is given by asking for the help of the head of the department who is considered to know and have a thorough knowledge of organizational management both internal and external to the organization.

Internal Strategic Factors	Item Weight	Rating	Item Weight x Rating
Strength			
Quality Personnel performance results	0,126	4	0,504
Determination of personnel performance standards	0,119	3	0,357
Health	0,112	3	0,3
Dedication	0,120	3	0,36
Loyalty / Discipline	0,118	4	0,472
amount			**2,03**
Weaknesses			
Human Resources	0,086	2	0,172
Lack of Creative	0,072	2	0,144
Work culture of personnel	0,087	2	0,174
Absence of development personnel	0,083	2	0,166
Lack of regeneration process	0,074	2	0,148
amount			**0,80**
Total Strengths and Weaknesses	**1,00**		**2.83**

Figure 4. Internal Strategy Factors (IFAS)

Source: Primary data processed, 2019

The total weight of item x rating in table 4.1 for the strength factor is 2.03 and the weakness factor is 0.80. This value is used as a reference for the current condition of the organization.

EFAS matrix

Before creating an external strategy factor matrix, we need to know in advance the External Strategy Factor (EFAS), namely opportunities and threats that might affect the organization in the future. The weighting of each factor starts from 1.0 (very important) to 0.0 (not important). Rating values can be given from a scale of 4 (outstanding) to 1 (poor). The rating for the opportunity factor is positive (the greater opportunity is given a +4 rating, but if the opportunity is small given a +1 rating. The rating of the threat rating is the opposite.

Figure 5. External Strategy Factors (EFAS)

External Strategic Factors	Item Weight	Rating	Item Weight x Rating
Opportunities			
Have supporting regulations	0,121	3	0,363
Good and adequate socialization media	0,115	3	0,345
Technology	0,124	4	0,496
Organizational Image in the eyes of the community	0,120	3	0,36
Organizational fulfillment	0,123	4	0,492
amount			**2,05**
Threats			
Number of work accidents	0,073	2	0,146
Demands for Technology Mastery	0,076	3	0,228
Government Policy	0,084	3	0,252
Infectious diseases	0,074	2	0,148
Desertion	0,085	2	0,17
amount			**0,94**
Total Strengths and Weaknesses	**1,00**		**3,01**

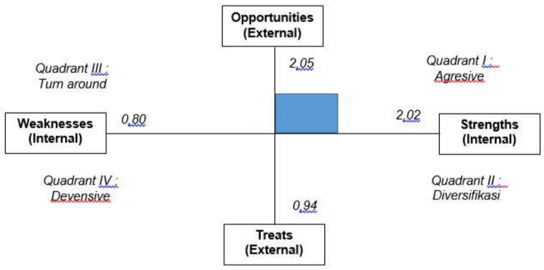
Source: Primary data processed, 2019

The total weight of item x rating in table 4.2 for the opportunity factor is 2.05 and the threat factor is 0.94. This value is used as a reference for the current condition of the organization.

Assessment of internal and external factors that can be obtained from the total score which is the sum of the multiplication of weights and ratings in the table above 4.1 and table 4.2 for external factors a total score of 2.83 and internal factors obtain a total score of 3.01. The next stage based on the total score obtained by the organization in the internal and external strategy factor table can be described the position of the organization to implement strategies that are in accordance with the current conditions, namely using the SWOT Diagram.

Based on Tables 4.1 and 4.2, the strength and weakness values (+) 1.22 and the value of Opportunties and Threats 1.11. From the identification of these factors, it can be described in the SWOT diagram below:

Figure 6. SWOT diagram



By paying attention to the SWOT diagram above, it can be concluded that the organization's position is in Quadrant 1. This shows that the situation is very beneficial because it has opportunities and strengths so that it can utilize the potential of the organization to be positioned above average.

Figure 7. SWOT Strategy

IFAS / EFAS	*Strength (S)*	*Weaknesses (W)*
	1.Quality Personnel performance results 2.Determination of personnel performance standards. 3. Health 4. Dedication 5. Loyalty 6. Organizational Location 7. Discipline	1. Human Resources 2. Less Creative 3. Personnel Culture 4. Lack of personnel development 5. Lack of regeneration process
Opportunities (O) 1. Have supporting regulations 2. Good and adequate socialization media 3. Technology 4. Organizational Image in the eyes of the community 5. Organizational fulfillment	*Strategy (SO)* 1. Utilize the rules that have been made as well as possible. 2. Utilizing existing social media as a means of personnel information and education. 3. With the presence of sophisticated equipment that is expected to improve performance capabilities 4. Strengthen the image of the organization by increasing discipline and loyalty of personnel	*Strategy (WO)* 1. Recruiting new employees according to competence required 2. More intensive promotion and education by holding introductory activities in various events in all regions. 3. Maintaining good relations with related parties so that cooperation can continue
Threats (T) 1. Number of work accidents 2. Demands for Technology Mastery 3. Government Policy 4. Infectious diseases 5. desertion	*Strategy (ST)* 1. Develop competitiveness of personnel by providing services, education and welfare. 2. Increase personnel innovation so that it has good character and dedication.	*Strategy (WT)* 1. Providing good and comfortable vehicle / transportation facilities so that the impact of accidents can be minimized. 2. Improving the welfare of personnel both in education and the income received.

Strategy (SO)

1. Utilize the rules that have been made as well as possible.
2. Utilizing existing social media as a means of personnel information and education.
3. With the presence of sophisticated equipment that is expected to improve performance capabilities
4. Strengthen the image of the organization by increasing discipline and loyalty of personnel

Strategy (WO)

1. Recruiting new employees according to competence required
2. More intensive promotion and education by holding introductory activities in various events in all regions.
3. Maintaining good relations with elated parties so that cooperation can continue.

Strategy (ST)

1. Develop competitiveness of personnel by providing services, education and welfare.
2. Increase personnel innovation so that it has good character and dedication.

Strategy (WT)

1. Providing good and comfortable vehicle / transportation facilities so that the impact of accidents can be minimized.
2. Improving the welfare of personnel both in education and the income received.

4. CONCLUSION

From the discussion that has been described and based on the data the writer obtained from the research as discussed in the thesis, the following conclusions can be drawn:

a. Based on the results of the analysis of internal factors which is obtained from the sum of the ratings and organizational strengths and weaknesses factors indicate the need to Utilize the rules that have been made as well as possible, Utilizing existing social media as a means of personnel information and education, With the presence of sophisticated equipment that is expected to improve performance capabilities, Strengthen the image of the organization by increasing discipline and loyalty of personnel and Recruiting new employees. According to competence required, More intensive promotion and education by holding introductory activities in various events in all regions, Maintaining good relations with elated parties so that cooperation can continue.

b. Based on the results of the analysis of external factors that is obtained from the sum of the ratings and the opportunity and threat factors the highest chance is found in the increasingly high fulfillment of personel who have high dedication, loyalty andcreativity.Byconsideringseveral alternatives as follows Develop competitiveness of personnel by providing services, education and welfare, Increase personnel innovation so that it has good character and dedication.

Providing good and comfortable vehicle / transportation facilities so that the impact of accidents can be minimized, Improving the welfare of personnel both in education and the income received.

c. The results of data analysis regarding the position of the organization using the SWOT analysis show that it is currently in a phase of organizational growth. The right strategy that must be applied based on SWOT ANALYSIS is by applying the SO (Strength - Opportunities) Strategy. This strategy is used to utilize the strengths of the organization to capture the opportunities of the existing organization. Includes:

1) Utilize the rules that have been made as well as possible.
2) Utilizing existing social media as a means of personnel information and education.
3) With the presence of sophisticated equipment that is expected to improve performance capabilities
4) Strengthen the image of the organization by increasing discipline and loyalty of personnel

5. Suggestion

Based on the results of research, discussion and conclusions above, the following suggestions can be given:

a. Even though the organization is at the safe point of Quadrant 1, the organization has enough power to take advantage of the opportunities available, but the organization also needs to pay attention to all possibilities that can arise suddenly by threats or changes in policy.

b. With the problem of Human Resources in the organization, it must pay more attention to a good management.

c. High competition now demands to always innovate and have the formation of character compared to other organizations.

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ANALYSIS OF THE PERFORMANCE OF GOVERNMENT ORGANIZATIONS IN REALIZING EXCELLENT SERVICES IN THE PUBLIC SECTOR

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Abstract

Analysis of the performance of public sector organizations is very important to progress the organization effectively and efficiently. This study aims to analyze the performance of City A in realizing excellent service to the community and to see the factors supporting and inhibiting the performance of Government Organizations in realizing excellent service to the community. To answer the intended objectives, the research approach used is qualitative by using five performance dimensions, namely productivity, responsiveness, responsibility, accountability, and service quality, and five factors supporting and inhibiting performance, namely personal, leadership, team, system, and contextual factors. The results show that the performance of City Government Organization A is quite good, which is shown from the productivity of the good performance of the Government Organization because there is an increase in targets every year even though it has not been fully achieved, and has worked following existing rules or regulations and has good accountability. Meanwhile, responsiveness is quite good, because it is still constrained by the service infrastructure that is not supportive, such as the lack of service facilities on the Government Organization Website, unclear information boards, and the service portal on the Government Organization website is not yet optimal. and for the quality of services, the results of service work are not yet good, because they are still constrained by the speed of service of government organizations that cannot be ascertained. As for the performance supporting factors in Government Organizations, namely the leadership and team factors, this factor has a positive effect on the performance of Government Organization employees. While the inhibiting factors are personal, systemic, and contextual factors.

Keywords: Organizational Performance, Excellent Service, Public Sector

1. INTRODUCTION

Public sector reform does not only occur in developed countries, but several newly developing countries also continuously reform their institutions, either in their systems or in the behavior of their officials. As in Indonesia itself, it is actively carrying out institutional reforms that are influenced by the New Public Management (NPM) model. But in its application, it is still constrained by the mental, knowledge, and skills of human resources which are still inadequate so that it has an impact on the low quality of performance of the current government apparatus (Amelia, 2014).

The main task of the government as the largest public sector organization is to create public welfare. Community welfare is a very multicomplex concept. Community welfare is not only in the form of material welfare but includes non-physical welfare which is more immaterial. In a country that is in the form of a state work has a king, but a state in the form of a republic owned by the state, namely the people or society. Therefore, it is the people or society that must be served by the state (Mahmudi, 2005).

On the other hand, the government is also expected to improve the quality of human resources that can improve the process of implementing public services, which can move more effectively and efficiently. Public sector organizations are currently required to be able to carry out innovations in government institutions and systems, by making innovations that are expected to improve existing public service facilities, which will form good governance that can improve organizational performance so that it can better meet the demands of the needs. public services such as productive, responsive, quality, transparent, accountable, fair services, the availability of service information that is easily accessible to the public and free from corruption, collusion, and nepotism (Angriyani et al, 2019).

The performance of the public sector is still in the public spotlight, especially the performance in the public service sector, which in practice in Indonesian regions is still not good enough, it is shown that there is still the performance of public service employees who are not responsive, accountable, low quality of service, complicated services - complicated, not cheap, less transparent, and the practice of corruption, collusion, and nepotism is still rampant (Dwiyanto, 2013).

Public sector organizational performance is the work achieved by a group of people in a public organization with the powers and responsibilities that the organization has previously determined. So that with the authority and responsibility given to the apparatus of public sector organizations, it is hoped that they will be able to provide the excellent service needed by the community (Ihsanuddin, 2014).

It is hoped that the City Government Organization has excellent and qualified personnel. With this competency, it can help the apparatus in carrying out their assigned duties, especially in providing excellent service to the community following their duties, authorities, and responsibilities in the field of licensing. That way, the performance of the Integrated Licensing Service Agency will be maximized and can provide licensing services under the current demands of the community, and will be able to restore public confidence in the performance of the public sector, especially in the field of licensing which they consider to be convoluted lately (Maharani, 2013).

The City A Integrated Licensing Service Agency has the task and function of providing services in the field of licensing to the community, which plays a very important role in the development of City A. Macro and micro-business licensing managed at the City A Integrated Licensing Service Agency itself are in the form of the establishment of a hospital, inpatient clinic, pharmacies, licensed health workers except for doctors and others. Furthermore, if more and more investors take care of business permits, both large-scale (macro) businesses and small (micro) business permits in the City A Integrated Licensing Service Agency, they can absorb labor in city A, thus indirectly influencing them. increasing the economic income of the people of City A.

Under Mayor A Decree Number 875.1 / 2 of 2011 concerning Delegation of Authority for Signing Licensing and Non-Licensing to the Head of the City A Integrated Licensing Service Agency, there are 30 (thirty) types of permits and non-licensing managed by the City Integrated Licensing Service Agency types of servants in City Government Organization A, which are so complex of public services that City A's Integrated Licensing Service Agency must provide to the people of City A, so it is hoped that the quality of performance of the Integrated Licensing Service Agency officials can be optimal in providing clarity in services, services fast, good employee responsiveness, punctuality, and availability of information in public services that are easily accessible by all levels of society.

However, the reality in the field is not under existing regulations, because the regional Ombudsman report in 2015 stated that public complaints about the performance of public services in City A itself are still high, compared to public services in other Central Java regions. Furthermore, from the Ombudsman report throughout 2015, most of the reports originated from public services in the City government, especially regarding permits. The second is the police and the third is the National Land Agency (Achmad Zaid, 2020).

Even though with the results of good work performance several targets have not been met and in-service practice at the City A Integrated Licensing Service Agency there are major problems, namely as follows:

1. The procedure for licensing investment is long and expensive, resulting in a high-cost economy;
2. Lack of information on investment
3. Weak business efficiency in encouraging increased production and innovation in the context of promoting investment
4. Low quality of Human Resources (HR) who are professional and have excellent service spirit, as well as limited information technology-based infrastructure;
5. Weak performance in the management of Regional-Owned Enterprises and the development of competitive regional potential (Widayanti, 2014).

Based on the Performance Report of Government Institutions, City government organizations, City A 2019-2020, there are still several work targets that have not been achieved. Furthermore, according to Widayanti (2014), it is confirmed that the City A government organization has provided quite a good service. Even though in realizing licensing services, there are still services that do not meet what has been determined according to public service standards, namely the problem of service speed and service schedule certainty.

One of the problems that have become an obstacle to the development of investment is the licensing bureaucracy. As it is known, the 2015-2020 government organization's Strategic Plan (investment) is needed to spur economic growth in a region and expand new jobs, which in turn will lead to the absorption of as many workers as possible. The condition of licensing services is still faced with a system that is not yet effective and efficient and is not under the demands and expectations of the community, this can be seen from the many complaints of the community, both directly and indirectly about organizational performance. The instability of policies and laws and regulations in the field of public services, convoluted procedures, inadequate infrastructure, limited-service coverage, the number of requirements that must be met, and the attitude of less responsive officers creates a bad image of the performance of the Regional Government. : City government organization strategic plan 2015-2020).

Based on the above problems, this research can formulate the following problems: How is the performance of the City A Integrated Licensing Service Agency in realizing excellent service to the community, and what factors are the supporting and inhibiting performance of City Government organizations.

The purpose of this study is to analyze the performance of the City A Integrated Licensing Service Agency in realizing excellent service to the community and what factors support and inhibit the performance of City A government organizations.

2. MATERIALS AND METHODS

2.1 Organizational Performance of City Government

a. Productivity

The productivity of the City A Integrated Service Agency can be seen from the success of the City A government organization in achieving the goals and objectives that have been previously set. The City A Integrated Licensing Service Agency has carried out what has become its responsibility in achieving its goals and objectives which have shown an increase in performance productivity every year, there are many dimensions of the performance of government organizations that have reached 100% target. In addition, the productivity of the City A Integrated Licensing Service Agency has also been good, which can be seen from the target and results of the realization of the 2020 licensing issuance service (Waheed et al, 2013).

The City A Integrated Licensing Service Agency also always strives to improve its performance which can be seen from the LKJIP of government organizations from year to year there is an increase in performance productivity, so it can be concluded that the productivity of City A's performance is good.

b. Responsiveness

The responsiveness of the performance of government organizations in providing licensing services is quite fast and responsive and has a polite and friendly attitude, but in the field of information and communication, services do need to be improved, such as government organization websites which are said to be online but not yet, secondly, the service information board is also It needs to be fixed because, from the results of observations, many licensing applicants do not know the service information boards. And it needs care on the suggestion and complaint trees and the waiting chairs for the service (Wibowo, 2013).

The City A Integrated Licensing Service Agency has tried to increase responsiveness to the community by providing infrastructures such as suggestion and complaint trees, information boards, and websites of government organizations, although the situation is still less than optimal, waiting rooms are not comfortable, and no regulation supports government organizations to further accelerate the completion time of licensing services. Currently, the service completion time is still long for the construction licensing sector, which is 15 working days. So that the conclusion from this responsiveness dimension is quite good because there are still some that need to be improved, to provide excellent service performance to the people in City A (Sinambela, 2012).

c. Responsibility

Responsibility in the City A Integrated Licensing Service Agency is well implemented, seen from the performance of government organizations under applicable laws or regulations. The licensing procedure in the City A Integrated Licensing Service Agency is based on Mayor A Regulation Number 1A of 2011 concerning Licensing Procedures and Work Relationships of the Integrated Licensing Service Agency with Regional Offices in the City Government Environment (Sedarmayanti, 2013).

Meanwhile, the performance of the Integrated Licensing Service Agency is following the existing administration or SOP. Even though the performance of government organizations in completing licensing services sometimes still exceeds the existing standard operating procedures, because government organizations have to coordinate with SKPDs related to licensing so that it takes a long time and results in not timely completion of services according to the SOP (Syafiie, 2011).

d. Accountability

The City A Integrated Licensing Service Agency already has quite a good responsibility, because LAKIP and LKJIP are available for accountability to the public, for the problem of free service fees other than the development sector paying fees based on Law Number 28 of 2009 concerning Regional Taxes and Regional Levies, but the problem is The time for completion of priority services in City A government organizations, sometimes it cannot be ascertained according to the existing SOP because usually, it can be faster than the SOP and sometimes it also exceeds the time limit for completing services in the SOP. So that the problem of certainty of completion time for licensing services is still the task of government organizations and needs to be corrected immediately so that it can provide excellent service to the community.

e. Quality of service

Service quality of City government organizations A. Service conveniences provided by government organizations, namely the availability of government organization portal websites, SMS gateway applications, although the website still needs improvement and refinement because the license registration form which should have been able to be downloaded via the website, in fact still cannot be downloaded, and the service cannot be online yet, so the licensing applicant still has to take care of all the requirements to come directly to City government organizations A, and the speed is not under the expectations of the community, therefore it can be concluded that the dimensions of service quality have not been implemented properly by City government organizations.

2.2 Research Methods

This research uses a descriptive qualitative approach. The data collection technique is done by using interview, observation, and documentation methods. The research location is located in the city government organization A.

The focus of this research is: analyzing the performance of the Integrated Licensing Service Agency in realizing excellent service to the community and analyzing the factors supporting and inhibiting performance in realizing excellent service. The research phenomenon includes the performance dimensions of Dwiyanto (2006), namely productivity (outcome and output), responsiveness, responsibility, accountability, service quality. And the factors that influence the performance of Mahmudi (2010): personal factors, leadership factors, team factors, system factors, and contextual factors.

The data analysis technique was carried out in three stages. These stages include data collection, data display, data verification, and concluding.

3. RESULT AND DISCUSSION

Factors Affecting the Performance of Government Organizations

a. Leadership Factors

The leadership factor in the City A Integrated Licensing Service Agency is well implemented. The leadership has provided encouragement, enthusiasm, and direction so that they can work well and provide excellent service to the people of City A, as evidenced by the results of observations and interviews that the leaders of government organizations have been providing motivation, the direction in morning apples, and once a month holding briefings for employees so that the leadership knows the complaints and shortcomings of each employee, that way the leadership can provide encouragement and direction if there is an employee's performance that is not working well.

b. Personal Factors

The City A Licensing Service Agency has a fairly good personal factor, which is proven to be able to complete work and provide good enough service, even though some employees are less competent and their work is still not good, but usually included in the training and there is directed by the head of the organization A City government, while the motivation of employees in government organizations is good because as State Servants who provide services to the community provide services according to their respective duties.

c. Team Factor

The government organization team factor is well applied to the performance of the City A government organization, because there has been good cooperation between co-workers, and the level of trust among co-workers is so well-established, so that when co-workers are having difficulty completing their work they help each other and support each other. As evidenced by the results of observations and interviews, when the licensing supervision division surveyed community satisfaction and lack of team members, then there were several personnel in the field of personnel who helped the survey until it was completed.

d. System Factors

The system factor has been implemented quite well because the work system of government organizations is under Mayor A's regulations, the existing facilities in government organizations currently to support performance are quite good, ideally, it is still lacking but government employees maximize existing facilities to work as well perhaps to provide excellent performance and service to the community. There is another dimension to this factor as an obstacle, namely the location of separate government organization offices, namely the 1st floor for services and the 3rd floor for the secretariat, making it difficult to coordinate with other fields in government organizations.

e. Contextual Factors

This contextual factor greatly impacts the performance of government organizations, especially when leadership changes, organizational structure, and policies, because with these changes there will also be changes in policies or rules, work positions, and working hours will be interrelated. So that it will hinder the work of employees of City A government organizations which have an impact on performance and excellent service. When leadership changes, the way to lead, organize and direct will change so that it will affect the work effectiveness of employees which will have an impact on their performance. Meanwhile, when there is a regulatory change it will also have an impact on the performance of the City A government organization.

4. CONCLUSION

a. Performance of government organizations

The performance of government organizations in realizing excellent service to the people in City A is quite good, because of the five dimensions of productivity performance, responsiveness, responsibility, accountability, and service quality used in this study, all three dimensions have been implemented properly. While the responsiveness dimension has been implemented quite well, this dimension is constrained by unclear service information, government organization websites that are not yet optimal, even though a menu for downloading forms and online registration has been provided, but it cannot be used by the public. Furthermore, one dimension that has not been implemented properly is the dimension of service quality in government organizations, because the results of licensing services are sometimes not on time or sometimes exceed the existing SOP provisions, and the ease of services provided is considered not good because it still requires a long service process. , as well as the inadequate service infrastructure that supports this.

b. Supporting Factors Performance of government organizations

Two factors are supporting the performance of government organizations in realizing excellent service in City A, namely: the leadership factor and the team factor, where the leadership of government organizations always provides supervision, encouragement, and morale to their subordinates, even always giving directions to employees whose productivity and discipline are lacking. good so that the productivity of employee performance increases. While the team factor itself in government organizations can be seen from the cooperation between colleagues that is well established in government organizations, helping each other between other fields or subsections that need assistance. That way it can work optimally and provide excellent service to the community.

c. Inhibiting Factors Performance of government organizations

Three factors are inhibiting the performance of government organizations in realizing excellent service in City A, namely: personal factors, it seems that there are still some employees who are still sometimes constrained in completing their work. Second, namely, the system factor, is still constrained by performance facilities that do not support employee performance so that they cannot work and provide excellent service and the location of separate government organization offices, namely on floors 1 and 3, thus complicating coordination between employees. Then the last inhibiting factor, namely, contextual factors. If there is a change in structure or a transfer of employee performance placement in the City A government organization affects performance productivity because each employee has to adjust to his new assignment.

FUTURE WORK

The further work that can be given on the performance problems of an integrated licensing service agency in realizing excellent service to the people in City A are as follows:

1) Improve the website of government organizations, so that in the future applicants can register online or download registration forms.
2) Fixing the problem of time certainty which is sometimes still not under the SOP, by coordinating well with the relevant SKPD in the licensing sector.
3) Immediately budget for funds to improve websites, suggestion boxes, and information boards in government organizations.
4) Then, for employees who are still not working well and have not followed the training, education and training should be included immediately.

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THE EFFECT OF WORK DISCIPLINE AND HR CAREER DEVELOPMENT ON COMPANY PERFORMANCE AND ACHIEVENT

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ABSTRACT

Assessment of the performance and achievement of each unit of the company is very important to be carried out every certain period to provide a trigger for each unit in maintaining or improving the performance and achievements to be achieved. As for the better, the level of performance and achievement achieved by each unit will provide benefits to the company. Although currently there are sophisticated technologies that greatly impact various company activities and can improve the efficiency, performance, and achievement of human resources, it is an important factor in an organization. Human resources are very important to be given direction and guidance from human resource management to produce optimal performance. The optimal form of performance in human resources is influenced by the work discipline that exists in each employee/worker and the success of career development activities carried out by the existing human resource management at the company. This research was conducted to see how the influence of work discipline and career development in human resources on the performance and achievements of the company.

Keywords: Work discipline, HR Career development, Company performance, and achievements.

1. INTRODUCTION

One of the strategic factors which is an important factor in the management of an organization is human resources. Even though the company has been supported by modern technology, the company cannot be separated from human labor. Human resources are very important to be given direction and guidance from human resource management to produce optimal performance. The optimal form of performance in human resources is influenced by the work discipline that exists in each employee/worker and the success of career development activities carried out by the existing human resource management at the company.

In carrying out its duties in each company unit, there are an assessment of the company's performance and achievements which are assessed by the HR and Talent Division of the central unit each semester in each year. The performance and achievement values obtained by each unit of the company are influenced by internal factors of each employee, namely work discipline and external factors carried out by the human resources division of each parent unit, namely the career development of each employee.

Based on the background of the problem above, the problem formulation of this article is to review the theory of the influence of the independent variable on the dependent variable as shown below:

a. How is the influence of employee/worker work discipline on company performance and achievement?

b. How is the influence of employee/worker career development on company performance and achievement?

2. MATERIALS DAN METHODS

2.1. Work Discipline

Work discipline as an attitude of respect, respect, and obedience to applicable regulations, both written and unwritten and being able to carry it out, does not evade sanctions if it violates the duties and authorities given to it. Work discipline is a form of employee self-control and regular implementation and shows the seriousness of the work team in an organization. Good work discipline refers to a person's sense of responsibility for the task assigned to him. Discipline that does not come from a human conscience will result in a weak and unsustainable discipline. The application of work discipline for employees aims to encourage employees to be willing and willing to follow various standards or rules that apply in a company, so that job abuse can be overcome (Arenofsky, 2017).

Good discipline will grow and emerge from the results of human consciousness. Good discipline reflects the amount of responsibility a person has for the tasks assigned to him, this encourages morale, morale, and the realization of organizational goals. Good discipline from employees will also show that the organization can maintain and maintain the loyalty and quality of its employees, from this discipline the value of employee performance can also be seen. In general, work discipline can be seen if employees come to the office regularly and on time, dress neatly at work, use office equipment with care, produce a satisfactory amount and quality of work by following the work methods specified by the company and completing work in a manner well and good. have high morale (Webb et al., 2013). Work discipline is very important to ensure the maintenance of order and the smooth execution of each task. Without high work discipline, it is difficult for companies to succeed.

2.2. Career Development

Career Development is several work positions held by a person during the work life cycle from the lowest position to the top position (Sinambela, 2016). Meanwhile, according to Bernardin and Russel (2013) career is the perception of a person's attitudes and behavior related to activities and experiences in the span of a person's work journey. Some opinions regarding the notion of career development are as follows.

1) Career development is a series of positions or positions occupied by a person during a certain lifetime.

2) Career development is a change in values, attitudes, and motivations that occur in a person because with the addition of age it will be more mature.

3) Career development is an effort that is carried out formally and sustainably with a focus on improving and increasing one's abilities.

4) Career development is a condition that indicates an increase in the status of a person in an organization on the career path that has been determined in the organization concerned. (Samsudin, 2010).

5) Career development is an effort made by an organization in planning the career of its employees, which is referred to as career management, including planning, implementing, and supervising careers (Sinambela, 2016).

6) Career development is a series of activities to prepare an individual for planned career advancement (Mondy, 1993).

According to Ardana (2012), there are three phases in the career development program, namely:

1) Planning Phase.

In this planning phase, the activity aligns the employee's design and the company's design regarding careers in the environment around them. The purpose of this phase is to identify the strengths and weaknesses of employees in carrying out their duties.

2) Briefing Phase

This briefing phase is to help employees to be able to make their plans into reality, namely by establishing the career they want and arranging the steps that must be taken to make it happen. So from the above statement, it can be concluded that there are three ways of approaching, namely: a. Briefing by organizing career counseling. b. Approach by providing career information services. c. Providing career education to employees to develop the knowledge and abilities possessed by these employees.

3) Development Phase

This development phase is the grace period that the employee uses to meet the requirements that make a move from one position to another that he wants. During this phase, employees can carry out activities to improve and increase their knowledge, skills, according to the desired position. So that employees must try to realize their creativity and initiatives that can support them to enter a position or position in the future. It can be concluded that career development is a process of increasing individual workability which is seen starting in planning activities and achieving goals.

2.3. Personnel Performance

Personnel Performance is the result of work both in quality and quantity achieved by a person in carrying out tasks according to given responsibilities (Mangkunegara, 2002). Employee performance is a performance as a result of performance that can be achieved by a person or group of people in an organization both qualitatively and quantitatively, following their respective authorities, duties, and responsibilities to achieve the goals of the organization concerned legally, does not violate the law and following morals or ethics (Moeheriono, 2012). Achievement or performance is a record of the results obtained from certain job functions or activities during a certain period (Bernadin & Russel, 2006).

The performance has been examined by many previous researchers including: (Ali, Limakrisna, et al., 2016), (Prihartono & Ali, 2020), (Ansori & Ali, 2017), (Harini et al., 2020), (Riyanto , Pratomo, et al., 2017), (Brata, Husani, Hapzi, 2017), (Agussalim, Kristin, et al., 2016), (Agussalim, Kristin, et al., 2016), (Ali, Limakrisna, et al., 2016), (Desfiandi et al., 2017), (Sulaeman et al., 2019), (Ansori & Ali, 2017), (Djojo & Ali, 2012), (Riyanto, Sutrisno, et al., 2017)), (Prayetno & Ali, 2017), (Ridwan et al., 2020), (Djoko Setyo Widodo, P. Eddy Sanusi Silitonga, 2017), (Agussalim, Ayu Rezkiana Putri, et al., 2016),

From several theories regarding performance, it can be concluded that performance is a result of work or the level of success achieved by workers in their field of work which can be directly reflected in the output produced both in terms of quantity and quality, according to the criteria applied to the job. Which can be measured through 1) technical capability; 2) Conceptual skills; 3) Responsibility; 4) Initiatives; and 5) Interpersonal relationship skills.

2.4. Company performance

Company Performance is a general term used to show part or all of the actions or activities of an organization in a period (Mulyadi, 2001 in Hanuman, 2011). According to (Mulyadi, 2007: 328 in Nugrahayu and Retnani, 2015) company performance is the success of the company as a whole in achieving selected strategic goals. Company performance is defined as the company's ability to achieve its goals through efficient and effective use of resources and describes how far a company has achieved its results when compared to previous performance (previous performance) and other organizational performance (benchmarking), as well as to what extent it has achieved its goals and targets. which has been determined (Muhammad, 2008: 14 in Nugrahayu and Retnani, 2015).

2.5. Company Achievements

Measuring company performance as a result of the management decision-making process is a more complex and more difficult issue because it involves issues of the effectiveness of capital utilization, efficiency, and profitability of company activities and concerns the value and security of various demands that arise against the company from third parties. . Company performance is a formal effort carried out by a company to evaluate the efficiency and effectiveness of company activities that have been carried out in a certain period.

2.6. Research Methods

The method of writing scientific articles is by qualitative methods and literature study or Library Research. Reviewing literature books according to the theory discussed, especially in the scope of Human Resource Management (HRM). Besides that, analyzing reputable scientific articles as well as scientific articles from journals that are not yet reputable. All cited scientific articles are sourced from Mendeley and Google scholars.

In qualitative research, the literature review should be used consistently with methodological assumptions. This means that it must be used inductively so that it does not lead to the questions posed by the researcher. One of the main reasons for conducting qualitative research is that it is explorative in nature (Ali & Limakrisna, 2013).

2.7. Conceptual Framework & Hipotesis

From the formulation of the problem of writing this article and reviewing literature studies from both relevant books and articles, the frame of this article is processed as below.

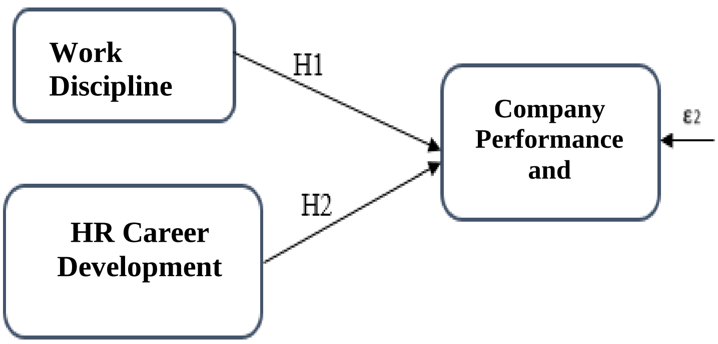

Figure 1. Conceptual Framework

Based on a theoretical study and the relationship between variables, the model or Conceptual Framework of this article to build a hypothesis is as follows:

a. The Effect of Employee Work Discipline on Company Performance and Achievement: (Carnilla, Mohammad Al and Gunawan, 2014) and (Ahmad Nur Rofi, 2012).

b. The Effect of Career Development on Employees on Company Performance and Achievement: Compensation on Employee Performance based on research results: (Ni Luh Putu and I Wayan, 2016) and (Novitri, 2016).

Based on theoretical studies, review of research results from relevant journals and conceptual frameworks, hypotheses can be formulated for further research, namely:

a. Employee work discipline affects the performance and achievement of the Company.

b. Employee career development affects the performance and achievement of the Company.

3. RESULT AND DISCUSSION

This article analyzes and discusses the variables of Human Resource Management (HRM), namely: employee work discipline, employee career development, and company performance and achievement.

3.1. Employee work discipline has a relationship and affects company performance and achievement.

Employee work discipline affects work performance in the company concerned, this statement is based on articles from relevant and reviewed research, including (Carnilla, Mohammad Al and Gunawan, 2014) and (Ahmad Nur Rofi, 2012). Based on the results of testing multiple linear regression analysis simultaneously and partially, as well as testing the f-test hypothesis and t-test disciplinary attitudes and behaviors have a positive and significant effect on job performance. (Carnilla, Mohammad Al and Gunawan, 2014).

According to (Ahmad Nur Rofi, 2012) by testing with partial analysis, the results of the F test and the results of the coefficient of determination (R2) show a positive and significant effect of work discipline and work experience on work performance. Multiple linear regression analysis is an analysis used to determine the effect of the two independent variables (X) simultaneously with the dependent variable (Y). The F test is used to determine the significant effect between two or more independent variables and the dependent variable simultaneously or together. A T-test is used to determine the effect of the independent variable partially with the dependent variable. The coefficient of determination (R2) test aims to determine how much influence the independent variable has on the dependent variable.

3.2. Employee career development has a relationship and affects company performance and achievement.

Employee career development has an influence on employee performance so that it affects performance and achievement for the company, this statement is based on relevant and reviewed research articles, including (Ni Luh Putu and I Wayan, 2016) and (Novitri, 2016). According to (Ni Luh Putu and I Wayan, 2016) based on the results of analysis and research that has been done, it can be seen that career development has a positive and significant effect on employee motivation. The better the career development of the employee, the higher the work motivation of the employee. Furthermore, employee work motivation has a positive and significant effect on employee performance.

Based on the analysis conducted by (Novitri, 2016) the influence of career development on employee work performance shows that the career development policies implemented by Company affect employee performance levels as seen from the characteristics of respondents based on the answers to a list of questions from several sub-variables work performance, exposure, organizational loyalty of mentors and sponsors and opportunities to grow.

4. CONCLUSIONS AND SUGGESTION

4.1 Conclusions

Based on the formulation of the article, the results, and discussion that are reviewed and discussed in this article, it can be concluded that to build a hypothesis for further research is:

a. Good discipline reflects the amount of responsibility a person has for the tasks assigned to him, this encourages work morale, morale, and the realization of organizational goals. Work discipline possessed by each employee will affect the performance and achievements of a company.

b. Career development carried out by human resource management in each company will affect the work motivation of each employee who carries it out, so that career development can affect the performance and achievement of the company.

4.2 Suggestion

Concerning the results of the analysis above, it is hoped that all companies and organizations can maximize work discipline and carry out development so that it affects employee performance and has a positive and significant impact on company performance and achievement. In addition, it is also hoped that the company will continue to improve the quality and quantity given concerning the company's output to advance the company's development. This paper can also be developed again with more detailed methods both qualitative and quantitative in nature.

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DISCLOSURE OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

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