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Strategy to Improve the Calibration Capability of Depohar 20 to Ensure the Quality of Maintenance Results in Supporting the Readiness of the Air Force's Defense System

Moch. Cholid Mawardi[1*], Rudy Sutanto[2], Sigit Purwanto[3]
Universitas Pertahanan Republik Indonesia
Corresponding Author: Moch. Cholid Mawardi Jannera61@Gmail.Com

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ABSTRACT

Depohar 20 plays a vital role in maintaining avionics, electronics, and precision measuring instruments. This study employs a descriptive analytical method with a qualitative approach that includes literature review, observation, and interviews. The findings indicate that improving the quality and quantity of human resources through training and certification is essential to enhance calibration capabilities. Moreover, improving infrastructure, such as temperature-controlled laboratories, procuring updated calibration equipment, and updating calibration management software like simkal, will help increase calibration reliability. Synergy with external institutions, such as educational and calibration organizations, is also needed to support the implementation of higher operational standards. Implementing these strategies is expected to enhance the operational readiness of alutsista, effectively supporting the indonesian air force in conducting air defense missions.

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INTRODUCTION

The Indonesian Air Force (TNI AU) has a strategic role in maintaining the sovereignty of the airspace of the Unitary State of the Republic of Indonesia (NKRI) (Setneg, 2010). In carrying out this task, the TNI AU requires operational readiness of the Main Weapons System (Alutsista) which is reliable and ready at any time to support air defense operations. The TNI AU's Alutsista consists of various complex equipment and systems, ranging from aircraft, radar systems, to electronic weapons devices (Kemhan, 2014). In order for all of these devices to function optimally, regular and proper maintenance is a must, including calibration of precision equipment which is very crucial to maintain accuracy and reliability.

Maintenance Depot 20 (Depohar 20) is a unit under the Air Force Materiel Maintenance Command (Koharmatau) which has special responsibility for the maintenance, calibration, and repair of avionics, electronics, and precision measuring instruments belonging to the Indonesian Air Force (Setumau, 2022). Depohar 20 plays an important role in ensuring that the defense equipment it manages is in the best condition and meets operational standards. However, in carrying out its duties, Depohar 20 faces various challenges that hinder its performance, especially related to limited human resources both in quality and quantity, inadequate laboratory facilities, and outdated calibration equipment and calibration management software that has not been updated.

This study aims to identify and analyze strategies that can be applied to improve the calibration capability of Depohar 20 so that the quality of maintenance results is maintained and the operational readiness of defense equipment can be more optimal. This study uses a descriptive analytical method with a qualitative approach, which includes literature studies, direct observations, and in-depth interviews with related parties. Through this approach, it is expected to obtain a deep understanding of the needs and constraints faced by Depohar 20 in the calibration process, as well as strategic solutions that can be applied to overcome these challenges.

The results of this study are expected to provide recommendations for improving the quality of human resources through training and certification, improving laboratory facilities, updating calibration and management devices, and increasing synergy with external institutions. The implementation of this strategy will not only help Depohar 20 meet higher calibration standards but also support the Indonesian Air Force in maintaining the readiness and reliability of defense equipment, so that air defense missions can be carried out effectively and efficiently.

LITERATURE REVIEW

Theory Strategy Improvement

Improvement strategy is an approach that aims to improve performance. organization through development sustainable And repair process systematic. According to Dr. Ahmad Susanto in "Teacher Performance Improvement Management", improvement strategies require collaboration from various parties and a sustainable approach to create a productive and effective environment. This shows that in the context of Depohar 20, collaboration

between the calibration department and related units is essential to improve effective maintenance capabilities.

Theory Guarantee Quality

Quality assurance is a systematic approach to ensuring that the products or services produced meet quality standards. Which set. According to Dorothea Revelation Ariani in "Management Quality", quality management is an integral part of an organization's operations that involves planning, controlling, and continually improving quality. For fulfil standard Which set. In context Depot 20, quality assurance is needed to ensure that the calibration of defense equipment is carried out according to strict standards, which has a direct impact on the operational readiness of the Indonesian Air Force's defense equipment. According to Weihua Liu In " Service Quality Assurance Design ", optimization of quality assurance can be achieved through a design that considers compliance behavior in meeting certain standards and conditions that allow for the achievement of the highest level of quality. This application is important in Depohar 20 to achieve consistent quality standards in the maintenance of defense equipment, thus supporting optimal operational readiness.

Theory Ensure Readiness

Operational readiness is the ability of an organization to perform specific tasks or functions with optimal effectiveness. Factors that influence readiness include organizational support, member motivation, and involvement active in process change. According to Qasim A. Al-Maamari In " Factors affecting individual readiness for change ", individual readiness for change is influenced by organizational support, communication, and employee involvement. In the context of Depohar 20, personnel and organizational readiness in carrying out optimal calibration requires effective structural support.

Implementation of SNI ISO/IEC 17025:2017 General Requirements for Competence of Testing Laboratories and Calibration Laboratories

The SNI ISO/IEC 17025:2017 standard specifies general requirements for the competence of testing and calibration laboratories. The application of this standard in laboratories calibration, like Depot 20, aiming For ensure that calibration results Which produced traceable to standard national and international, so that it can be relied on to support the operation of the Indonesian Air Force's defense equipment. Guaranteed metrological traceability is essential, especially in the process of maintaining defense equipment which requires high accuracy to ensure reliability. And readiness tool main system weapon (defense equipment) in various operational situation .

Regulation of the Chief of Staff of the Air Force Number Perkasau/48/ XII/2020 Dated December 17, 2020 Concerning the Organization and Duties of Koharmatau

Regulation of the Chief of Air Force Staff (Perkasau) Number 48/2020 stipulates the structure and duties of Koharmatau as the Main Functional Command directly under the Chief of Air Force Staff. Koharmatau is responsible for the maintenance and production of materials, as well as coaching workshop equipment and technical publications within the Indonesian Air Force. This task includes the maintenance of medium to heavy level defense equipment to ensure optimal operational readiness. In this context, Depohar 20, as one of the Koharmatau units, plays an important role in maintaining various critical components such as radar, avionics, and precision measuring instruments. Referring to this Regulation, Depohar 20 has the responsibility to maintain the quality and reliability of the main weapon system (alutsista) through accurate and standardized calibration.

Perkasau No. 48/2020 also emphasizes the importance of sustainable development of resources and equipment. For Depohar 20, this means providing calibration laboratory facilities that meet standards and ensuring skills personnel in accordance with need maintenance. In supporting the operational readiness of defense equipment, Depohar 20 is committed to increasing calibration capacity to ensure the quality of maintenance, in accordance with the mandate given by Koharmatau. Effective implementation of this regulation is the basis for a strategy to increase calibration capabilities that support the readiness of the Indonesian Air Force.

Regulation Head Staff Force Air Number 40 Year 2022 DateL 7 November 2022 about Organization and Task Depot Maintenance 20 Koharmata

Air Force Chief of Staff Regulation Number 40 of 2022 stipulates the role and responsibilities of Maintenance Depot (Depohar) 20 as an implementing unit in lower Command Maintenance Material Force Air (Koharmatau). Depohar 20 has the main task of maintaining, restoring and repairing equipment. avionics, electronics aircraft specific, weaponry air, instrument on simulators, precision measuring instruments, as well as medium to heavy maintenance for various strategic assets of the Indonesian Air Force, including Unmanned Aerial Vehicles (UAVs), Water Combat Maneuvering Instrumentation (ACMI), tool test, And component fabrication .

This regulation emphasizes the importance of regular maintenance and restoration to maintain the quality and operation of defense equipment, which is an important element in the air defense strategy. As a unit responsible for calibration and testing, Depohar 20 plays a role in ensuring that all avionics and electronics are in optimal condition and ready for use. Not quite enough answer This covers arrangement traceability metrology and compliance with international standards in calibration, as regulated in SNI ISO/IEC 17025:2017.

Commander Regulation Number Perpang/3/Iv/2007 Dated 12 April 2007 Concerning Air Technical Instructions (PTU) Number 92 Concerning Implementation of AUP Calibration

TNI Commander Regulation Number Perpang/3/IV/2007, especially Technical Instructions Air (PTU) Number 92, confirm that implementation calibration tool precision measurement (AUP) in a way periodic is element vital in support accuracy and measurement accuracy. PTU No. 92 stipulates AUP calibration as the main requirement For fulfil standard technical And reliability in maintenance TNI AU defense equipment, which directly affects operational readiness and security. According to the provisions of this regulation, proper and standard calibration No only ensure accuracy results maintenance but Also impact on the efficiency of material use and improve the operational safety of defense equipment. Through accurate calibration, the risk of measurement errors can be minimized, which plays an important role in reducing damage due to the use of non-standard measuring instruments. In addition, a systematic calibration process provides a stronger foundation in maintaining the quality and effectiveness of equipment used by the Indonesian Air Force.

METHODOLOGY

The method used in compiling the journal on improving the calibration capability of AUP Depohar 20 as a problem solving in this paper uses a qualitative method with a descriptive analytical approach based on experience, literature studies and observations to improve the calibration capability of AUP in Depohar 20.

RESEARCH RESULT AND DISCUSSION

Implementation Theory Strategy Improvement

The improvement strategy at Depohar 20 aims to optimize calibration performance through a continuous approach, involving collaboration and improvement. Process in a way comprehensive. According to Dr. Ahmad Susanto, collaboration inter-unit collaboration is an important element in the improvement strategy, ensuring that all personnel and units are aligned in achieving goals. In the context of Depohar 20, this collaboration includes joint efforts between calibration personnel and other technical staff in overcoming existing limitations, such as personnel shortages. Based on data Which served on Chart 4.1. Show that from 80 personnel Which ideal, consists of from 19 officer, 50 non-commissioned officer, 6 enlisted, and 5 State Civil Apparatus (ASN). Currently, only 45 personnel are available, with details of 14 officers, 22 non-commissioned officers, 6 privates, and 3 ASN, resulting in a high workload and potential lower quality calibration. Situation This emphasize importance kaizen approach that emphasizes small but consistent improvements at every level of the organization.

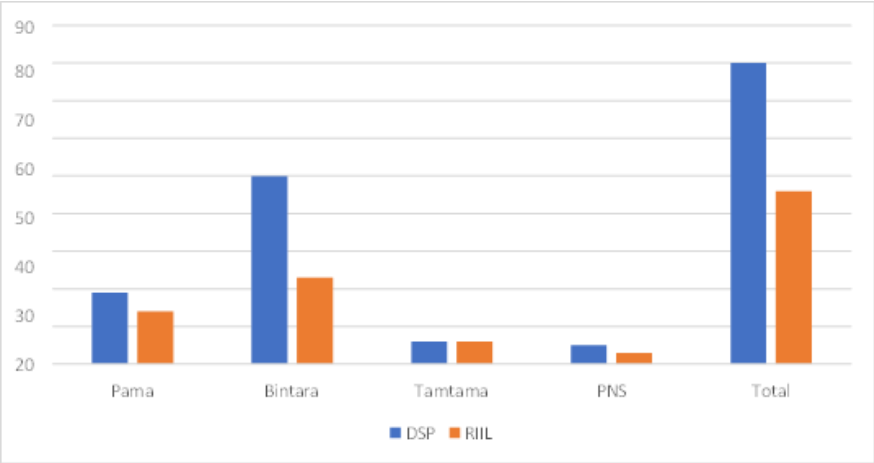


Figure 1. comparison DSP with Real Personnel Laboratory Calibration of Sathar 22 Depohar 20 Year 2024

Source: Data Processed

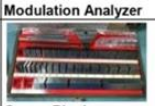
Approach SWOT also become base in analyzing condition depot 20. swot analysis allows identification of internal strengths and weaknesses, as well as external opportunities and threats relevant to the calibration conditions at depohar 20. depohar 20's main strengths include moderate to heavy maintenance capabilities on various defense equipment, while its weaknesses are limited personnel and outdated equipment. through swot, strategic steps can be designed to mitigate threats and maximize opportunities in supporting the readiness of the indonesian air force.

Hoshin Kanri, as explained by david hutchins, underlines the importance of coordination at all levels of the organization in achieving continuous improvement. in depohar 20, a structured approach such as this allow every part work in synchronization for achieve high quality standards. this ideal condition has not been fully achieved, due to the lack of personnel which qualified tall and limited training adds to the challenges in achieving optimal calibration maintenance. training and development skills in technology calibration modern required to achieve the expected calibration capability.

Guarantee Quality Results Calibration

Quality assurance in the calibration process is the foundation for ensuring reliable results and meeting operational standards. Based on the theory of Dorothea Wahyu Ariani, quality assurance is an integral component in operations management, including planning, controlling, and improving quality. In Depohar 20, this is relevant because the calibration laboratory has a crucial role in maintaining metrological traceability for various measuring devices. precision. However, data in accordance Picture 4.2. show that Some of the standard measuring instruments in the laboratory have expired and require calibration. repeat. A total of 32 necessary tools scheduled calibration repeat through external agencies to meet the established standards. This condition indicates an urgent need to maintain stable calibration quality so as not to disrupt the operational readiness of defense equipment.

NO	NAMA BARANG	PN	SN	SPESIFIKASI	KALIBRASI TERAKHIR	INTERVAL (BULAN)	KET
1	2	3	4	5	6	7	8
1	 Auto Collimator	TA1/142-12	103S	142/11 (2,4m) 142/11,13,14 (7,5 m)	28-09-20	12	
2	 Reff Standard Capacitor	SC100A	2966	1000 pF	22-03-20	12	
3	 Dc Standard	732B	2093034	1v & 10 v	25-09-20	12	
4	 Voltage Reference	7001	14261130	1v & 10 v	25-09-20	12	
5	 RLC Digibridge	1689M	G1-14060986	R = 0.0001 Ω to 99999 KΩ L=0.0001 mH to 99999 H C=0.0001 Pf to 99999 µF 0.0001 nf to 99999 µF	23-09-20	12	
6	 Calibrator	5522A	292903	- Volt AC 0 - 1020 V - Volt DC 0 - 1020V - Ampere 0 - 20 A - Tahanan "R" 1,1 GΩ Capacitor 220 pF - 110mF	23-09-20	12	
7	 Counter	CNT-90XL	134721	0,3 - 27 GHz	22-09-20	12	
8	 EPM Series Power Meter	N1913A	MY50001748	-35 dBm to +20 dBm (>500mHz) -30 dBm to +20 dBm (50mHz - 500mHz)	20-10-20	12	
9	 Range Calibrator	11683A	MY51330001	-25 dBm to 20 dBm 3 µW to 100 mW	22-09-20	12	
10	 Spectrum Analyzer	E4446A	SG54370002	3 Hz to 44 GHz	25-09-20	12	
11	 Primary Frequency Standard	5071A	US493530008		-	12	

1	2	3	4	5	6	7	8
12	 PXA Signal Analyzer	N9030A	US53310129	3 Hz to 44 GHz	18-09-20	12	
13	 PSG Analog Signal Generator	E8257D	MY53400731	250 KHz - 50 GHz	22-09-20	12	
14	 Modulation Analyzer	8901A	A04055	150 KHz - 1300 MHz	09-10-20	12	
15	 Gauge Block	SS81A1X	21379.8	0 - 4"	-	12	
16	 Torque Tranducer	2000-14-02	0714801H-8200	200 - 2000 ft lb	24-09-20	12	
17	 Weight Set	-	07492	0 - 20 Kg	12-09-20	12	
18	 XL Laser Measurement System	XL-80	228JO9	-	-	12	
19	 Force Calibration Kit	8002600-200	504	0 - 50.000 Lbs	-	12	
20	 Platinum Thermometer	Model 8163Q	A91S4461	-200 ^{0}C - 661 ^{0}C	22-12-20	12	
21	 Air Data Calibrator	ADC-2500	217	Altitude (-2000 - 109.985 Feet) Airspeed (0 - 1050 knot)	-	12	
22	 Reference Pressure Monitor	3322392	2270		-	12	
23	 Modulation Meter	5401	245	Glide Slope 334.1 MHz Localizer 108.10 MHz	-	12	
24	 Oscilloscope Calibrator	9500B	924053439	0.1 Hz - 600 MHz	-	12	

1	2	3	4	5	6	7	8
25	 Resistor Standard	4020B	1530261	1 Ohm	-	12	
26	 Induktor Standard	1482L	11077	100 mH ± 0.1 %	-	12	
27	 Spring Tester	L30	01		-	12	
28	 Torque Wrench	QD5R1000	615502957	0-1000 LBFIT	21-03-23	12	
29	 Beban DWT	MS-7001-35-AF	2862	100-4500 g	12-09-20	12	
30	 Electronic Dead Weight tester	RPM4 E-DWT A200 Me-L	2322	LOW RANGE 0-6000 Psi HIGH RANGE 0-30000 Psi	19-09-20	12	
31	 Load Cell	N-1	5734	200 lbs (8,8964 kN)	24-09-20	12	
32	 Load Cell	N-1	5597	20000 lbs (88,9644 kN)	22-09-20	12	
TOTAL RENCANA ANGGARAN BIAYA							

Komandan Satuan Pemeliharaan 22,

Catur Adi Nugroho, S.T., M.Tr.SOU., M.Han.
Letkol Lek NRP 532412

Figure 2. Expired Calibrator
Data Source : Report Program Sathar 22 Depot 20 TA. 2023

Ansarullah Lawi explained that quality control involves a series of activity Which designed For ensure product or service according to specifications, through technique control. In Depot 20, control This includes procedures that ensure that each measuring instrument used meets the appropriate calibration standards, which serve as a basis for ensuring the accuracy of maintenance results. Challenge technical other, like Which seen on figure 3. indicates damage to central AC and split AC , affecting the laboratory temperature which should be stable to meet calibration requirements. Failure to maintain the laboratory temperature at the specified level will negatively impact the accuracy and reliability of the calibration, highlighting the importance of integrated quality assurance in the operational process.

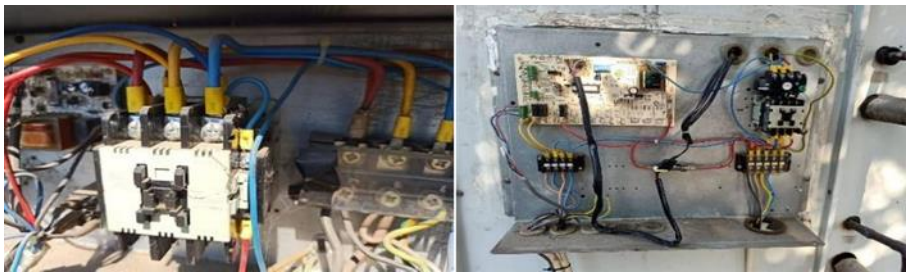


Figure 3. Condition Regulator Temperature (AIR CONDITIONING Central)
Source: Onsite Observation Results

Implementation of the Calibration Management Information System (SIMKAL) will be very helpful in managing calibration administration, rescheduling measuring instruments, and monitor all over process calibration with efficient. SIMKAL can provides historical data, calibration status, and equipment records, so that Depohar 20 can improve accuracy and efficiency in managing calibration schedules and equipment maintenance on an ongoing basis.

Ensure Readiness Personnel And Organization

Readiness operational in Depot 20 need support And high personnel involvement, especially in the face of limited human resources. According to Qasim A. Al-Maamari, individual readiness for change depends on support organization, communication Which effective, And involvement personnel. Support from management, as outlined by Ugochukwu Chinonso Okolie, can increase personnel engagement and motivation to achieve the calibration standards. tall. However, condition real in Depot 20 show that during the last six years there has been no further training at the Precision Measurement Equipment Laboratory (PMEL), Which previously important in development technical. Lack of access to training like this can impact personnel skills, resulting in required initiative quick for increase skills technical through more adequate training.

Figure 4. Training PMEL last in American Union (USA) year 2018
Source: Photo Obtained from Research Locus

Collaboration between Depohar 20 and higher education institutions and other external institutions will be very beneficial in strengthening personnel capabilities. This partnership can include advanced technical training, calibration management, and access to new technologies that support Depohar 20's tasks and functions. Through this collaboration, personnel can gain relevant skills and the latest knowledge, which is very important to support operational readiness and reliability.

Compliance To Standard And Regulation

Depohar 20 is required to comply with the SNI ISO/IEC 17025:2017 standard, which specifies traceability and controlled environment requirements for processes. calibration. Standard This ensure that laboratory fulfil condition stable operation for accurate measurement results. However, infrastructure limitations, like the damage part big air conditioning central And air conditioning split , hindering the fulfillment of the required temperature in the laboratory. This damage hinders the maintenance of a stable temperature that is crucial in the calibration process, potentially affecting the quality of the calibration results and, ultimately, the readiness of the defense equipment. This traceability standard also includes the importance of up-to-date technical publications. Technical Orders (TOs) as guide technical operational require periodic updates. However, data shows that some TOs in Depohar 20 have not been fully updated according to the latest developments in the industry. Without Updates This, There is risk big that the procedure calibration No will be appropriate with practice best Which needed, so that Updates become crucial to ensure operational accuracy and reliability.

Infrastructure Support Additional Through Synergy And Decision Support Systems

Synergy between Depohar 20 and various institutions and industries is important For overcome limitations And increase capability calibration. Cooperation with accreditation bodies such as the National Accreditation Committee (KAN) can help laboratories in Depohar 20 to implement better calibration standards. In addition, synergy with local and international defense sectors allows access to the latest innovations and efficient calibration methods.

Figure 5. Visit Team Assessor from Committee Accreditation National
Source: Photo obtained from Locus study

Mobile Calibration Unit or vehicle help maintenance field Also important for increase flexibility Depot 20 in give Calibration support in various locations, especially in radar units in remote areas. With this unit, the calibration process can be carried out quickly and accurately in various locations that require it. System this is very important to remember radar is a key component in system defense air Which must operate with accuracy high. In side other, implementation system Supporter decision Which intelligent will increase readiness technical facility calibration And increase effectiveness in response need operational. System This help in manage, plan, And prioritize repair Which required For equipment which damaged or Which need calibrated repeat in a way periodically.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study indicate that the strategy for improving calibration capabilities in Depohar 20 requires a comprehensive approach that includes optimizing human resources, improving laboratory infrastructure and facilities, and implementing quality assurance standards and synergizing with external institutions. By implementing the SNI ISO/IEC 17025:2017 standard and collaborating with accredited external laboratories, Depohar 20 can improve the accuracy and reliability of calibration results, supporting the readiness of TNI AU defense equipment more effectively. The addition of devices such as the Mobile Calibration Unit and the implementation of SIMKAL are expected to improve calibration efficiency in the field and ensure more accurate data management. In addition, strong synergy with external parties such as academics, media, and the defense industry supports innovation, technology updates, and increasing the capacity of calibration personnel. With the integration of these strategies, Depohar 20 can achieve continuous improvement and meet modern operational demands in supporting TNI AU air defense missions.

ADVANCED RESEARCH

Further research on strategies to improve calibration capabilities at Depohar 20 needs to be focused on strengthening a precise, efficient, and internationally standardized calibration system to ensure the quality of maintenance results in supporting the readiness of the Indonesian Air Force's defense equipment. In-depth studies are directed at modernizing digital technology-based calibration equipment, automation, and integration of testing systems with real-time data to improve process accuracy and efficiency. Studies also need to explore the application of the Internet of Things (IoT) in monitoring the calibration cycle, including a cloud-based recording system that facilitates tracking and validation of measurement results. In addition, an evaluation of the standard operating procedures (SOP), calibration technician competencies, and personnel certification systems needs to be carried out according to the regulations of the Ministry of Defense and the TNI. Increasing collaboration between Koharmatau, Balitbang Kemhan, and national testing institutions such as BSN and KAN will support the standardization and recognition of calibration results nationally and internationally. The results of the research are expected to

be the basis for developing a roadmap to improve the calibration capabilities of Depohar 20 that is adaptive to the demands of modern maintenance technology, while ensuring the operational readiness of defense equipment reliably and sustainably.

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