Reliability, Availability, Maintainability and Safety (RAMS) Components and Potential: A Review

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ABSTRACT: RAMS implementation in Railway System is still developing and caught the attention of many researchers and institutions. The information about application of RAMS in other industries such as petroleum, chemical and avionic is already matured and widely implemented. The discussion and publication of railway RAMS need to be encouraged and continued. As railway authority started to make RAMS analysis compulsory for all phase of railway life cycle, it is important to bundle and address the component together rather than as individual discipline. This paper extracts all the important components an equation regarding RAMS.

Keywords: RAMS, Asset Manager, Railway

1. INTRODUCTION

RAMS is an integrated discipline that includes reliability, availability, maintainability and safety measures and characteristics tailored to operational and project objectives of a system. It is commonly used for railway system operation and engineering. Railway assets are meant for long period usage with high reliability and availability without compromising its safety as an utmost importance[1], thus the maintenance of the assets need to be carried out optimally and cost effectively. This management tool has great potential to improve railway transportation's effectiveness and economic competitiveness against other mode of transportation.

2. COMPONENTS OF RAMS

Railway RAMS has a significant impact on the quality of service provided to customers[2]. Table 1 shows component of RAMS:

Table 1 Components of RAMS

Reliability	**Definition**: Ability of an item to perform a required function under given condition for a given period[3].
Availability	**Definition**: the ability of a product to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided[3].
Maintainability	**Definition**: the probability that a given active maintenance action, for an item under given conditions of use, can be carried out within a stated time interval when the maintenance is performed under stated conditions and using stated procedures and resources [3].
Safety	**Definition**: the state of technical system freedom from unacceptable risk of harm [5].

Where λ is a Failure Rate, MTTF is a Mean Time To Failure, MTBF is a Mean Time Between Failure, MTTR is a Mean Time To Repair and μ is a Repair Rate.

Common tools used to assess RAMS are Fault Tree Analysis (FTA)[4], Failure Mode Effect Analysis (FMEA)[5], Reliability Block Diagram[6] and many more.

3. BENEFITS OF RAMS

RAMS is widely use in designing and operating Critical Infrastructure (CI) such as petroleum platforms, servers, critical public construction and building and many more[7]. RAMS requires suppliers, project executer, tendering department, project owner and rail operator to meet certain standard. It would guarantee the reliability and safety of the operation. Other than that, the cost incurred from project concept to the project design phase and final phase of decommissioning could be calculated and determined[8]. As stated before, RAMS is

becoming common term among railway engineering practitioners. This is due to the history of railway that span of more than 200 years back as the first railway track built in 1825[9]. So, the implementation of RAMS in railway, considering the age of railway engineering is relative new.

RAMS is a tool that can be used to understand how a system works, especially a complex and multi-interface system such as railway. It is a substantial management to predict vulnerabilities, weakness and possible failure and explain how they affected the system's quality and performance. It also employed the strategy to improve the operation's quality to achieve optimal long-term availability and select the best maintenance solutions[10].

4. CONCLUSIONS

RAMS is a huge theme in system design and project execution as well as asset management. It regulates the product or system life cycle from the requirement and designing phase until decommissioning phase as stated in System Life Cycle. With wide range of interdisciplinary engineering, the technical, logistic, and cost-effective methods are introduced in RAMS that makes it as best candidate for complex system managing tools.

There are several management and technical challenges and difficulties in implementing RAMS. At the government level, it needs to understand the procedure and technicality of RAMS. A regular replacement of officer in charge at the authority would hamper the effort at the government legal and executive role. Other than that, suppliers, contractors and owner or train operator company (TOC) need to be educated on RAMS activities at the individual level. Once the government makes it compulsory, the other players in railway industry will make their effort to meet the authority's requirement.

On the technical level, RAMS parameters need to be calculated and relegated along its life cycle. At the procurement level, suppliers will provide the relevant parameters and main contractor would calculate all the required item. These documentations would be needed by local authority, TOC and outsource maintenance team in later life cycle of railway. Multinational companies normally do not share their parameters in depth, making the RAMS analysis difficult and based on many assumptions. A legal framework in term of information exchange need to be developed so that all actors play their respective roles.

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