Survey Based Risk Assessment for Advancing the Safe Industrial Railway Transportation

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Abstracts: The linkage between producers of raw materials and final consumption goods producers is an end-to-end procedure involving transport machines, equipment, and technological influence. After producing final consumption goods, they are not left idle in the company; instead, they are transported to various market utilization parts. To familiarize and evaluate risks involved in the transportation system between suppliers of raw materials to producers of goods than to final consumers of such goods, Railway transport seemed more secure and confidential. We hypothesized the value of management of possible collision risks. The outcomes herein validate this hypothesis bearing in mind possible shipping of hazardous or perishable goods for quite a more extended period. A closer consideration of the new Train Control System (TCS) in train controls can be a better idea for new market entrants.

Keywords: Hazards, Industrial Transportation, Risk Assessment, Survey.

1. INTRODUCTION

Massive quantities of hazardous products are transported by different modes of transport every day. This must comply with the rules and regulations governing such products' transport sector to be safely delivered to various target destinations. Often transport of these products is associated with many risks such as fire breakouts, environmental spills, explosions, or significant damages to the environment.

A lot of consequence is associated with transporting such goods through roads because citizens are highly exposed to uncertain occurrences. Therefore, safety policies should incorporate better and elaborate measures to curb such incidences towards achieving a zero-accident target in our transport systems. In this regard, we chose the Rail transport system based on its reliability, safety, and carriage capacities. We realized that rail transport is free from external interference because basically, no one of sound reasoning can risk his/her life to try and interfere with a train. Moreover, it has large carriage capacities to accommodate more goods transported; therefore, trains are accommodative.

It is necessary to inspect, regulate, and control the transport of these goods by rail to avoid unnecessary accidents or other negative impacts on the surface. National and international rules governing this sector must therefore be enforced following the law. However, the rail transport system is not limited to risks, and therefore, there is a need to ensure proper conditioning of the trains and goods in transit. Railway safety metrics are influenced by factors like the risk prevalence of people around the railway, including workers.

This paper aims to analyze the significant uncertainties associated with transporting hazardous goods by rail while assessing significant factors such as railway accidents and thefts regarding safe transport, aiming to reduce the risk of accidents and recommend transporting dangerous products. Being one of the broadest transport systems worldwide, we also focus on possible technological and modern advancements that can be implemented to better the sector while also aiming to raise revenues and create more job opportunities to reduce the unemployment rates. This paper's working methods include analysis of proposed approaches, case studies, conclusions, and future research recommendations.

2. PROPOSED METHOD

We implemented the Survey-based evaluation method, a procedure for harmonizing individual experts' ideas and forming a unanimous solution to deliberate on a train control system (TCS). An expert, in this case, is a knowledgeable and experienced person. The size of an expert group will determine evaluation criteria based on the following assumptions; the expert is knowledgeable and able to provide the relevant information required. This information obtained is immediate solutions, even if they might not be the real ones.

Therefore, we choose respondents based on competence and acceptance to participate in this Survey without being influenced by external parties. We will select 36 respondents to deliver based on the classical test theory, which states that the reliability of decisions and the number of experts is linked by rapidly extinguishing nonlinear relationships (Batarlienė, 2020). Questionnaires were distributed through mails to the 36 respondents involved in the transportation of hazardous products and 12 more to the staff. The questionnaires inquired about respondents' personal information and addresses and detailed analysis of technologies used; accidents encountered so far, among other factors.

This research is therefore designed to examine the following;

- The regularity of hazardous goods being transported in a year
- Common dangerous goods are often transported.
- Problems encountered while transferring these products.
- If TCS and other Technological advancements employed in the transport process will be beneficial to the sector and how effective?
- To determine common causes of rail accidents, and
- To explore the need for training of railway staff.

3. CASE STUDY

For this study, I acquired the Canadian Railway customer response data for comparison purposes. This would help identify areas that needed improvements. For instance, to facilitate efficient train services in Canada, the government needs to implement the Train Control System to ensure goods are delivered on time and without disturbances. TSC is generally a radio-based and computerized system suited to train controls. The system is designed to receive commands about the train's traveling schedule, and then it directs wayside objects.

TCS will be segmented in either of three ways: segment 1- where information is relayed through a passive voice. This level enhances safety against speed and passing signals. Segment 2- will involve a direct intervention or train speed control, automatically allowing high-speed confidentialities at short headways. It also enables movement tracking of the train to eliminate chances of accidents or interference before the intervention. Segment 3- is solely responsible for train spacings by monitoring train heads and tails. Therefore, each train must have an n integrity control system and another electronic device that can control the speed.

By implementing this noble idea, security will automatically enhance, and carriage capacity will increase because adjacent railway lines can be controlled effectively. The TCS will be a model high-speed train management system to accomplish high speeds with proper and definite controls outlined. Therefore, it will be more comfortable to transport perishable goods to longer distances without the worry of going bad. However, proper maintenance techniques must be put in place to keep the operations efficient and generate more revenues with little risk. Risks such as fire, accidents, and spills will be significantly reduced because this system will detect and automatically

control the train while in motion. It will surely bring a new dimension to the transport sector with surety of advanced carriage and security.

4. RESULT ANALYSIS:

Questionnaires were inquiring on train efficiency, reliability, and sustainability. For example, Is the train effective? (Yes/No)? The questionnaire was designed with open-ended questions. These are questions that do not restrict the respondent in answering. They can interpret and answer based on their understanding. For example, what do you think of the new technology? Or how does the old train control system impact your efficiency in transport? This would lead to varied explanatory responses essential for proper assessment.

According to the questionnaires collected, before the TCS, transport by train was 60% in reliability, 40% in speed, and 50% inefficiency. This could not sustain significant and regular transport needs of raw materials or finished goods in the Canadian economy. If TCS is implemented and put into useful work, reliability will be increased to 90% while speed increased to 98% with efficiency at 98%.

Out of the 36 employees at a railway station, 70% supported that the trains were inefficient when it comes to product delivery, 20% claimed that the system was adequately functioning as it was designed, while 10% remaining without a stand. 80% argued that the old train had no modern modification deeming it technologically misfit on technological advancements. 5% were in support of the old model and system, while 15% were still undecided.

Looking at the questionnaires from the 12 staff members inquiring on the railway system's state as a substantive and reliable business, 80% claimed that few individuals would go in for railway system, with 20% posting as undecided. Moreover, 95% confirmed that there were relatively low revenues raised from the railway system. This hindered advancement and upgrade to modern systems. 5% claimed the little revenue was just sufficient enough.

Overall, the TCS seems acceptable in the market, with 96% of employees supporting this new technology. 85% of staff also stood in support of the TSC protocol. We strongly advise that this new proposal be submitted to the relevant authorities for review, further research, and analysis, then implementation when deemed fit enough to benefit the railway's system. Anticipated revenue projections suggest that it will create more revenue for the country and create more job opportunities to curb high unemployment rates with the introduced operation sectors.

1. FMEA on Automated Rail Trains

Elements	Types of failure	Computing effects	Train effects	Detection By	Severity of consequences	Ref
Control Application	Locked Down	Last outputs are maintained	No control: acceleration, brake, steering.	Operator	Uncontrollable Train	1
Speed Sensor	Sensor	Proper regulation of speed cannot happen	Speed without regulation will cause increase or decrease in desired speed.	Computer/ Operator	Train is unpredictable in speed and accidents can occur.	2
Accelerator Actuator	Blocked or locked down	N/A	-No acceleration -Acceleration without request	Operator	This sort of incident occurs while testing new train components	3
Brake Actuator	Electric motor or wire used to activate brakes	N/A	No braking	Pilot/System	Possible collusion with another train or other obstacle.	4

CONCLUSION AND FUTURE WORK

The respondents are more efficient than old systems; the new model is reliable and fast. However, a model-based evaluation is essential during the review and implementation of the TCS. This model has also presented low-

risks associated with, for example, the transport of harmful goods over long distances. Every model cannot be 100% effective, and this is not exempted; however, its probability of failing is so limited to the tune of 1%. It will also be a significant revenue source that will support both the nation and sustain itself for a projected 100 years. More peculiar innovations have to be devised during this projected 100-year period of successful existence to improve the system. It will as well create employment opportunities from top-notch positions to lower positions. By this, the youthful generation and the jobless will be embraced into new jobs with new experiences.

We want to develop a more diverse technological advancement in carriage containers and the future shipping industry. We have notably recognized the shipping sector as a vital part of the economy that requires more innovative ideas. Our motive is to reduce the risk of occurrences in the transport system due to the operating system's failure and accidents. Consider; if the transport system rots, no businesses will occur anywhere, for instance, no supply of raw materials and not the supply of finished product to the desired markets. The market would suffer stagnation, and the risk of regression will be encountered. With a robust model, the shipping sector will also undergo significant technological advancements.

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