TOWARDS REFORMING SRI LANKA RAILWAYS: INSIGHTS FROM INTERNATIONAL EXPERIENCE AND INDUSTRY EXPERT OPINION

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S L J E R

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Abstract

Growing of the automobile industry and the demand for personal car use and chronic financial deficits in the balance sheets of rail operators have significantly affected the rail industry deterioration since 1970. However, gradual rail reforms were carried out by many countries to eliminate financial and operational issues and to develop their rail transportation systems. Sri Lanka has more than 150 years of history in railway operations, yet it is still in a weak position in terms of the operational efficiency and the financial position. The main purpose of this paper is to explore the key issues and root causes for the operational and financial deficiencies of Sri Lanka Railways and identify the best reform model in the light of world rail reform experiences and rail industry experts' opinion. A semi-structured questionnaire was employed to interview twelve railway industry experts. Content analysis, Analytical Hierarchy Process (AHP) Method, and Policy Delphi Method were the main analytical techniques employed in the study. The results of the analysis showed that the vertical separation of the ownership between rail service operation and rail infrastructure provision is suitable for Sri Lanka Railways and, given the existing operational and financial characteristics, the reform steps should mostly be designed as in the case of the German- Sweden hybrid model of rail reforms.

Keywords: *Railway Reforms, Operational Inefficiencies, Analytical Hierarchy Process, Policy Delphi Method, Sri Lanka Railways*

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INTRODUCTION

The industrial revolutionary background along with the need for mass volumes of freight and passenger transportation led to railway industry innovations. Innovating diesel engines and electric engines were the turning points in railway industry and thereby rail as a main passenger and freight transportation mode were commenced in many countries in the whole world. However, since 1970, the railway industry has been impacted by the awakening of the automobile industry, and the rise in demand for personal car use and continuous chronic financial deficits in railways accounts. The rail network congestion, air pollution, and poor accessibility and the economic and the financial losses in passenger and freight transportation in rail industry were major issues that led to rail deterioration. Low market retention, lower investment, higher debt accumulation, poor coordination, and management are the major reasons that led governments to consider rail reforms.

Reforming or restructuring of railway organisations entails a vast scope and that might be regarded with existing assets, liabilities, organizational structure, recruitment, safety regulations, and technological aspects. Countries have taken the path of long-term stepwise rail reforms to avoid issues and developed rail transportation as a competitive transport mode over other modes. On a broad perspective, railway reforms were framed according to the country specific features such as the nature of transport system, the political context, the economic situation, the business and the regulatory environment, and the public sector continues to play a dominant role as infrastructure managers, and in some cases as service providers in a vertically integrated structure (Laurino, Ramella and Beria, 2015).

In 1864, the British introduced railways to Sri Lanka and the initial purpose of the rail establishments were to transport coffee, tea, and machinery from the hill country. Having institutionalized it as the Ceylon Railways in 1902 under Ceylon Government Railway Ordinance, it continues to operate as a government department under the Ministry of Transport featuring a vertically integrated governance structure.

The development of the plantation was expanded to the West, North-West and South-West and the railways were used to transport coconut, rubber, cinnamon (Sri Lanka Railways, 2020). When considering SLR's status quo, the Sri Lankan government retains the state-owned monopoly railway structure for both the infrastructure provision and the operational services. The infrastructure development, developing policies, implementing new mechanisms and structural changes in the railway transportation sector should be carried out through the Ministry of Transport. Acquisition and maintenance of moving assets such a locomotive and wagons, rail infrastructures track and platforms, signalling, and telecommunication, providing service to the movement of people, and freight are the primary functions of SLRs.

The railway industry in Sri Lanka has been significantly affected by road development and increased automobile use and the resulting competition in both the passenger and

freight sectors (United Nations, 2003). Over the time, several rail lines such as Opanayake via Rathnapura, Yatiyantota, and Nuwara Eliya were dismantled due to the high level of operational losses while the remaining lines also kept on continuing to lose market share. Even though Sri Lanka Railways (SLR) had significant issues in planning, operational, investment and budgeting, infrastructure management and safety, there were no significant reforms since 1983. The year marked the change of name of Ceylon Government Railway, (C.G.R.), to Sri Lanka Railways (S.L.R.). Until 1993, the 'Railways Authority Act' was passed to introduce greater commercial flexibility into SLR but was repealed in 2005 (The Government of Sri Lanka, 2005). The government of Sri Lanka still searches for the best options and strategies and considers alternative mechanisms to bring in investments in the form of Public-Private Partnerships (United Nations, 2003). One such initiative is the introduction of an Open Access Policy that enables private freight owners to use underutilized tracks with their own investment in operation and maintenance (United Nations, 2003).

SLR provides multiple passenger services categories such as long-distance, suburban, local train and intercity and express train services. SLR's average modal share for passengers is approximately 3.4% and it roughly carries 135 million of passengers annually (The Central Bank of Sri Lanka, 2019). Even though the total modal share is low, SLR contributes in carrying high passenger capacities in urban areas while relieving road congestion (Sri Lanka Railways, 2018). However, overcrowded railway

compartments are usually seen during peak times in the coastal line and the mainline in Sri Lanka Railways. SLR is one of the politicalized and unionized government enterprises and as a result, international assistance to SLR restructuring has been often negated (Asian Development Bank, 2007). This paper discusses several critical issues and root causes for the issues in SLR. The main aim of this paper is to propose a reform process for SLR through which managerial and operational issues and root causes could be handled better.

INTERNATIONAL EXPERIENCES IN RAILWAY REFORMS

Different countries have followed different organizational structures and business models to develop their railway industry. For instance, New Zealand, Mexico and Japan have vertically integrated rail management and operational systems while Sweden, UK and Germany have vertically separated railway systems. Rail liberalization and reshaping of the organizational structure have been carried out in many countries with several steps involved (Hilmola, Ujvari and Szekely, 2007). A review of these reforms and the post reform performances contribute to identify the steps, processes, the resulting governance structure concerning operational ownership, infrastructure ownership, land management, subsidization, regulatory level, labour management and evaluate the success of the reforms.

Japan Railway Reforms: The growth of motor vehicles, labour disputes, inappropriate service delivery and high fares have slowed down the growth and development of the rail industry in Japan in the early years. By 1987, the Japanese Railway had 25 trillion-yen debt as a long-term accumulation. Between the period 1960s to 1980s, the rail market share reduced from 30.8% to 13%. 400,000 workers with a strong unionized environment served the railways before the restructuring (Chen and Haynes, 2015; Kopicki and Thompson, 1995). A committee was appointed to study organizational restructuring and management reforms recommended to split the centralized structure including assets/liabilities. In 1897, JNR (Japan National Railways) was divided into six vertically integrated and regionally separated passenger rail companies and one for freight. Most of Japans' intercity rail lines (including Shinkansen), HSR (High-Speed Railways) commuter rail lines and other infrastructures are owned by the Japanese Rail group and some of them are fully privatized (e.g., JR East, JR Central, JR West and JR Kyushu (KJR)). JR Hokkaido (HJR), Shikoku (SJR), and Freight are still controlled and governed by The Japan Railway Construction, Transport and Technology Agency (JRTT). As railway infrastructures belong to railway operating companies, they had the market power in regional railway services (Kurosaki, 2018). HJR, SJR, and KJR were provided with financial support from the Management Stabilization Funds (MSF) as the rail companies cannot operate financially viable services without government subsidies (Kurosaki and Alexandersson, 2018). After the reforms, the service quality, punctuality, speed, accessibility, and labour productivity increased while reducing the amount of government subsidy offered. Negative consequences were such that profitable companies did not enhance the infrastructure development in the rural areas, and the passenger services in regional areas declined. Further, the operators had no interest in freight transportation, and only focused on profitable passenger rail lines. Even though the freight operating companies had access to the rail network, there were entry barriers such as the difficulty of getting the running schedules on tracks as rail tracks are fully occupied by passenger railway companies (Kopicki and Thompson, 1995).

Sweden Rail Reforms: Difficulties in reinvesting for infrastructure development, increasing incremental subsidies along with the time and closing rail lines due to high maintenance cost were the major causes for the restructuring railway industry in Sweden. Statens Järnvägar (SJ) is the Swedish State Railways operator that had to face comprehensive financial issues. Hence, the government of Sweden decided to change the organizational structure of the Swedish State Railways in 1986 (Kurosaki and Alexandersson, 2018). After 1988, the Swedish rail network was vertically separated. Sweden is the first country to restructure railways with vertical separation in Europe. Sweden followed the "road model" and was motivated to increase competitiveness by upgrading rail infrastructures. In 2000, SJ was reformed under four main market segments, namely (a) SJ AB (major passenger), (b) Green Cargo AB (major freight), (c) Jernhusen AB (railway stations, rail-related real estate) and (d) Euro Maint and Swemaint AB (rail infrastructure construction and maintenance). Banverket (established in 1988) is

the National Rail Administration which is responsible for tackling complementary operations and infrastructure maintenance. In 2009, the Swedish founded Transportstyrelsen (Swedish Transport Agency), the regulatory body for road and rail transport. The main functions of the regulatory body are enforcing the rules, issuing licenses and certificates, registering the change in ownership, managing congestion, and collecting vehicle taxes. In 2010, Sweden established 'Trafikverket' (The Swedish Transport Administration) which is responsible for long term planning of the transport system including rail, road, maritime and aviation. This entity handles 80% of the infrastructure management role of the Swedish Railways. The deregulation of freight railways also gradually took place in Sweden. Most of the regional services are now provided by the private operators and all the other services are provided by SJ. Sweden fully opened the railway passenger market for competition in 2010 (March, Wood, Railway and Bank, 2013). With the gradual opening of the rail market between the periods 2000 to 2010, Sweden's passenger-kilometre share has increased by 37% and the freight modal share has been increased by 19%. Therefore, both performance indicators showed positive outlook which was mainly due to railway reforms. The safety level has also increased significantly due to several new initiatives undertaken with rail reforms (Charanwanitwong and Fraszczyk, 2018).

British Rail Reforms: The reason for the restructuring of British railways is similar to the ones in Sweden. British Railways also was fully separated by dividing operational services and infrastructures. In 1994, Railtrack Company was established as a fully privatized, listed company. They had the ownership of tracks, signalling, level crossing, and stations. In 2002, Railtrack company was bankrupt and, later a new entity namely 'Network Rail' was established which is controlled by the government as a non-profit company. The Network Rail Company has the responsibility for operating the network, collecting track access charges, charging for the commercialization activities and being accountable for the performances. Scheduling and timetable management is also under the Network Rail Company.

ORR (Office of the Rail Regulator) was set up initially for economic regulations. But now, there are several tasks added to ORR such as regulation of safety, strategic planning, issuing of licenses by certifying safety, and giving approval for rolling stocks. Network access is given to operators through a competitive tendering process. The government offers a subsidy to profitless passenger operators. But, freight transportation is not franchised and there are no subsidies provided by the government (Charanwanitwong and Fraszczyk, 2018).

High labour productivity, high rail traffic for both passenger and freight services, effective resource utilization, higher industry output are major positive benefits of the restructuring railways in the UK (Finger, 2014). From 1992 to 2000, the passenger mileage has increased by 21% and freight ton mileage has increased by 19%. During the

post reform period, 2003-2013, rail passenger-kilometres increased with an average annual growth of 2%, while the real value of rail fares have increased at a steady rate between 1% and 2% per annum (Cartmell, 2016). Even though the UK has the most liberalized rail system in the world, it still massively depends on government subsidies (Cheng, 2010; Ozkan, Yanginlar and Kalayci, 2016). Nevertheless, UK rail privatization led to a 24% increase in planned passenger train services (since 2009), an increase in freight share by rail, and an increase in punctually, reliability and the passenger satisfaction of the service (Department for Transport, 2019; Network Rail Limited, 2019).

German Rail Reforms: The main reasons for the rail restructuring in Japan, UK, and Sweden were common to the German railway restructuring. The German government removed the federal government ownership of its rail operation services in 1994 and re-established the rail operating body as joint-stock companies. At the first stage of the reform, the government-owned 100% of joint-stock company shares (Gangwar and Raghuram, 2017). The key milestones of the German railway reform include:

- Vertical separation between the rail infrastructure and service operation.
- The opening of the rail network for third parties and the introduction of a fare structure to track payments.
- Financial and contracting responsibility for regional passenger services to federal states (regionalization).
- Constitution of Federal Railway Agency for licensing and supervision.

In the first phase, German government separated commercial activities from the infrastructure provision. For that, 'Berliner Verkehrsbetriebe' also known as BEV, was established in 1994 and took over the long-term liabilities such as track development, maintenance, and signalling from DB and DR. As the next step, the DB and DR companies were merged and then DB and AG were created and it is a state-owned, joint-stock company for rail service provision. Labour productivity was increased by reducing excess labour and the BEV was responsible for dealing with them. Four separate DB AG entities were introduced to operate - long distance passenger plc, local passenger plc, good transport plc, and infrastructure plc. German railway reforms include the organizational separation, accounting separation, and the removal of cross-subsidization among divisions. As an independent entity, EBA oversees non-discriminatory access to rail tracks, technical supervision, and authorization of all railway operators in Germany (Gangwar and Raghuram, 2017). At the second stage of the reform, EBA added another entity to the DB AG namely, DB Station and Service.

In 2007, DB underwent specific reforms regarding its organization structure. Rail passenger transport and rail freight transport were organized under two distinctive organizations. In the third phase of the reform, German government partially privatized its DB Group. After the reform, the burden on taxpayers was reduced as subsidies were removed. The productivity and efficiency of the rail operation and services also significantly increased. At present, DB Schenker is one of the best rail freight facilitators

in the European rail sector. From 1994 to 2012, passenger-kilometres increased by 36% while freight transportation increased by 58%. Yet 90% of the rail market is dominated by DB AG and that adversely affected competition. Other private operators have less priority due to infrastructure dominance of DB AG and the cutting down of the subsidy which led to dismantling of the number of regional rail routes (Cheng, 2010; Gangwar and Raghuram, 2017). Hence, the subsidy continues to play a greater role in the sustainability of rail transport provision in Germany in a similar manner to the UK rail reforms.

French Rail Reforms: France undertook full separation of rail infrastructure from operations in 1997 creating a separate infrastructure company, RFR (Réseau Ferré de France) and another independent public body, SNCF (The Société Nationale des Chemins de Fer Français, which is France's national state-owned railway company), oversee track allocation and management (Friebel, Ivaldi and Vibes, 2010; Monami, 2000). The reform includes regional franchisee rail operators who operate passenger rail service regionally with leased or outright purchase rolling stock. The rail service operator, allotted to 6 regions determine the planning of passenger rail services and their coordination with the other modes in consultation with SNCF (Monami, 2000). Yet, all regional rail services are required to franchise services to the monopoly rail passenger operator SNCF (Nash, Smith, Crozet, Link and Nilsson, 2019).

Thailand Rail Reforms: Thailand has a state-owned monopoly railway structure that reveals common issues with a monopoly structure. In the last 30 years, Thailand heavily invested in road transport infrastructure development and, meanwhile, the share of railway industry contribution declined. The rail freight transport model share reduced from 9% to 2% from 2000 to 2013. 90% of passengers used a third-class train compartment and 70% of them were benefiting from subsidized train fares. Until 2005, SRT (State Railway of Thailand) could only cover the rail operating costs, and in 2013, 23% of losses were recorded (March et al., 2013). In this backdrop, Thai policy makers adopted European rail liberalization models as reference to reform SRT. Entry restriction on foreign operators, a fare scheme for the multiple service production and for the new entrants, a rail regulatory body under a government ministry, separation of the rail organization into several rail operating firms are main features of Thai railway reforms which are mainly aligned with German reform model (Charanwanitwong and Fraszczyk, 2018). Debt-free start with a new working capital, railway infrastructure ownership to the government while liberalizing rail services, independent government regulatory bodies for land and non-core assets management, horizontal separation and minimizing investment for HSR were the results of Thai Railway reforms (March et al., 2013).

China Railways Reforms: The government is the owner of the Chinese railway industry. China has over 130,000 km of railway length and in previous decades they rapidly established a High-Speed Rail (HSR) network and increased rail connectivity. The

booming economy, industrial development, government priority for the HSR network have positively affected China's railways. Newly deployed HSR systems and the existing rail systems are managed by old organizational structure which led to several management issues. Chronic financial debts, less system reliability in some areas, the monetary requirement for further developments are key issues in the China rail system (Cheng, 2010; Pittman, 2004). Since 1986 China has undertaken several rail reforms and yet those were not effective in mitigating the issues. The Ministry of Railway (MOR) centralized the managerial power and as a result, several management issues were found. There was also a minimum private sector participation in rail services. MOR supervised policy and regulatory functions – technical, planning, investment, financing, scheduling, rail administration, 18 Regional Rail Authorities and their running service operation, and infrastructure management entities. However, since 2013, China has significantly shifted towards restructuring policies. In 2013 railway reforms were introduced to develop railways as a market-oriented railway system. Private sector involvements, joint venture railway participation have begun since 2013 due to the extraordinary expansion of HSR. Reducing the role of government, and facilitating the companies to access the market were seen as effective solutions for the above issues (Yu, 2015). Railway reforms after 2013 include:

- Separating the government administration from enterprise management
- Dissolving MOR and separating the government functions from rail operations
- Separating the regulatory and administrative responsibilities from commercial operations
- Establishing MOT as the responsible authority for overall transport sector planning and development policies
- Establishing a new body for the rail; namely, State Rail Administration (SRA) which sets standards regarding technical sections, safety aspects, service quality and checks the corruption through the construction.
- Establishing China Railway Corporation for the commercial operation of the railway. Under the CRC, 18 Regional Rail Authorities are organized as conventional rail networks and train operators.

Indian Railways: Indian Railways has a vertically integrated organizational structure under the purview of the Ministry of Railways. Railway infrastructure and services are divided into geographically based zonal authorities and thereby allowing them to operate trains. Non-government railways also exist as joint ventures. Private sector investment in railways development is low. The government failed to provide rail service in a better way by fulfilling customer demand. Over the years, the modal share has dropped owing to poor service quality. Nevertheless, excessive labour, lack of safety, poor infrastructure, public service obligation, protection for competitiveness have been addressed recently by the initiated policies (Bogart and Chaudhary, 2012). Gangwar and Raghuram (2017) revealed that the German railway restructuring model should be followed by the Indian

railways with its industrial background. Separation of infrastructure and operation, open access to the private companies, restructuring the organization based on market segmentation, minimizing cross-subsidies among the variety of services and the regionalization of the financial responsibilities were observed as restructuring initiatives.

EU countries began to follow three major types of rail reform models and each mode has considerable differences. Swedish model completely separated state-owned organizations and opened it to fare competition. In German model, they have vertically separated organizations for train service and retained both infrastructure and operation mostly by the same holding company. Hence, the German model is not appropriate for the privatization due to the actual independence for capital allocation and charging activities, and the difficulty of management control of a large body (Link, 2016). Furthermore, the government is responsible for infrastructure planning and to the infrastructure development while service operation is under commercialized based or subsidized contractual basis (Grushevska, Notteboom and Shkliar, 2016). The French model comprises a separate infrastructure manager but one which in turn subcontracts much of its activity to the major operator. French model can be explained as a hybrid model version of holding company model (German) and vertically integrated model and was effective as the vertically integrated operator remains as a dominant firm in the market that has a fair degree of separation between infrastructure and operation and there is no real competition as separate subsidiaries within a holding company (SNCF) structure are deprived of the chance of entering new operators (Nash, 2008). Table 1 presents a comparison of reform models of Sweden, German and French including countries that followed their rail reforms concerning each model.

Table 1: European railway institutional frameworks

Responsibilities	Swedish model (Complete Separation)	German model (Holding company model)	Fenech model (Separation of key power)
Investment	S	(I)	S
Timetabling	S	(I)	S
Maintenance & renewal	S	(I)	I
Train control	S	(I)	I
Safety	S	(I)	I
Countries following the model	Britain / Finland / Denmark /Netherlands /Norway /Spain /Portugal /Slovakia /Lithuania	Austria / Belgium /Italy /Latvia /Greece /Poland /Latvia	Czech/Estonia /Hungary /Slovenia /Luxembourg

S → separated.

I → integrated with the main operator under a contract from the infrastructure manager.

(I) → integrated with the main operator but in separate subsidiaries

Source: Based on (Nash, 2008; Finger, 2014)

Swedish model adopted a fully separated reform model under which separate entities are responsible for investment, timetabling, maintenance & renewal, train control and safety. German model of reform considered separate subsidiaries integrated with a main operator while in the French model, all functions are contracted under a main management unit.

There is a considerable additional cost involved throughout the separation of rail infrastructure from the service operation. But it is proved to be the best way to create some level of intra-modal competition effectively (European Commission, 2016). Several cross country and individual country case studies generally reported operational efficiency improvements after railway reforms and developing cost centre based restructuring is vital for improving operating efficiency for both infrastructure and human resource cost management (Asmild, Holvad, Hougaard and Kronborg, 2009). In particular, liberalization of rail passenger services in Germany, Sweden and Britain has led to a significant growth in the rail passenger market, including regional markets without requiring additional government subsidies (Nash et al., 2019).

RESEARCH METHODOLOGY

The methodological framework of the research includes four stages: (a) Thematic analysis of literature on world railway reforms, (b) Descriptive analysis of eight years of SLR operational and financial performances to identify trends. (c) Thematic analysis of interview data collected from a Delphi method-based interviews to identify the issues and derive expert opinion on reforms (d) an analysis of data collected from a questionnaire survey of industry experts using Analytical Hierarchy Process (AHP) to identify major issues in Sri Lanka Railways.

Rail restructuring models in Japan, Sweden, Germany, Great Britain, France, Thailand, China, and India (summarised in the Annexure - A) were reviewed to observe issues, restructuring steps, and outcomes, and to determine the key issues, past performance, past organization structure, reform process, current organization structure as well as the current performances. The reform processes and policy initiatives that were learned from world examples were used to develop the semi-structured questionnaire. In addition, eight years of SLR operational and financial performances collected from the reports of the Central Bank of Sri Lanka were analysed using descriptive statistics (CBSL, 2019). Delphi, TOPSIS, SWARA, AHP and Comparative analysis are the analysis methods found in literature on rail reforms. The Delphi method is useful when the research does not have a precise analytical technique to formulate a policy, develop priorities and forecast the future (Hasson et al., 2000). AHP and Delphi techniques were used for the study according to the following reasons.

- The lack of scientifically established findings, recommendations, or suggestions for rail reforms in Sri Lanka
- The ability to use a group of experts' consensuses on rail reforms in improving policies or predictions

- The ability to eliminate dominancy
- The ability of participants to express their opinion freely and broadly

There is no clear theoretical framework or universal guidelines for the Delphi technique. The group of respondents can differ according to the topic of the research (Habibi, Sarafrazi and Izadyar, 2015). When the researcher recruits experts with different specialties, then the individual judgments of 5 and 10 experts are sufficient (Clayton, 1997). In this study, twelve experts were interviewed while covering all sub-departments of SLR. From the 2nd round, 8 experts were interviewed, who were also involved in the 1st round.

Content analysis of the interview data was carried out using NVivo software to identify major issues and root causes in the Sri Lanka railway industry. NVivo analysis was employed after the 1st round of the Policy Delphi method. Analytical Hierarchical Process (AHP) method was employed to derive the prominent reform possibilities. The purpose of using the AHP method was to determine prioritized reform areas in the Sri Lankan context. For this purpose, a survey was carried out with 12 industry experts (The sample includes 9 persons from top managerial positions in SLR, two former general managers and an academic). The paired comparison matrix (reciprocal matrix) with ten main criteria were derived after a thorough literature review. After completing the matrix, the consistency ratio was derived to validate the results. Based on the literature review carried out thematically and the findings of Delphi surveys and AHP, a comparative analysis was performed to identify industry issues that were common to SL and other countries before rail reforms and the degree of success in solving each issue after reform.

Design of the questionnaire and the interview script

In the first round, the questionnaire was developed as a semi-structured questionnaire which included open-ended questions with a 5-point Likert-Scale. A convenient sampling method and focus group technique were used to collect data from the railway industry experts. A 5-point Likert scale questionnaire was used for the 2nd round which was developed based on the results of the 1st round inputs and the result of the literature review. After executing the 02nd round, the experts' consensus was evaluated to determine the degree of experts' agreements with the statements expressing railway industry issues. Cronbach's alpha was used to measure the internal consistency and reliability of the data inputs.

Degree of consensus

Policy Delphi method transfers the facts derived from the opinion of the industry experts into a numeric scale from the 2nd round with minor changes to the statements in the questionnaire until the optimum consensus level of the experts reaches. There is no universal agreement to indicate sufficient consensus level. In this research, the consensus level was taken as 75% to 100%, and the consensus level is determined by the IQR

(Interquartile Range) (Clayton, 1997; Rayens and Hahn, 2000). If IQR is equal or less than one and greater than 0.75, then a particular statement has an acceptable consensus level. Otherwise, the process should be carried out until the optimum consensus for all the statements are obtained. A 5-point Likert rating has been used and '1' represents strongly agreed psychometrics and 5 for the strong disagreement. Mean (average) of the statements exposes the average aggregate opinion of the participants and when the mean was less than 2.5 it was taken as the agreed statement and statements with above 2.5 were considered as a disagreed statement.

DATA ANALYSIS AND RESULTS

Operational and Financial performance analysis

According to the SLR performance reports for the last 5 years (2013-2017), SLR realized an increase in the passenger capacity by 6.0%. Yet, the overall model share has decreased. Figure 1 shows a drastic decline of the operating trains km since 2016. Even though operated trains km declined, the number of passenger-km has increased as the passenger demand per train has increased.

**Figure 1: Decrease of train km and increase of pax**
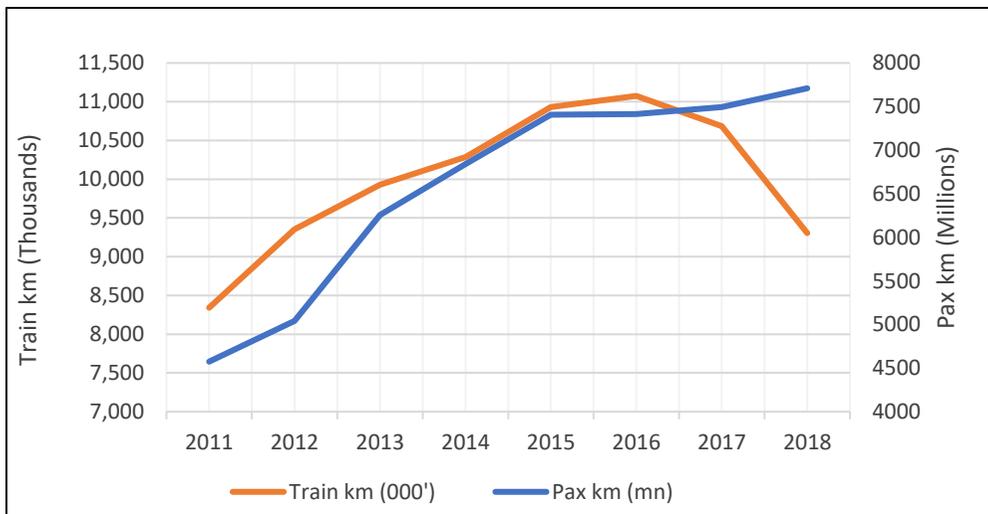
Source: Authors' illustration based on CBSL Report 2019 and Railway Performance Report 2018

The ratio between operating expenses to revenue is about 2.4 and SLR incurred a net loss of 7.6 billion in 2017. Although trains km operated have declined, the operational expenses demonstrated a sustained increase. Therefore, the actual loss is more than three times the revenue. Although passenger km is on the rise, the rise is offset by the higher increase in operational expenses. Hence, Sri Lanka railway currently operates under an operational period which demonstrates X-inefficiency. Figure 2 shows the past years' operational expenses and operational revenues. In 2018, there were more than 17,500

employees in the SLR. SLR's main revenue is generated through provision of train service operations and the rest of the incomes are negligible. Less comfort and lower punctuality are influential factors for passengers to shift from rail transport to road (Bandara and Rathnayake, 2019).

Figure 2: Operating costs and revenues
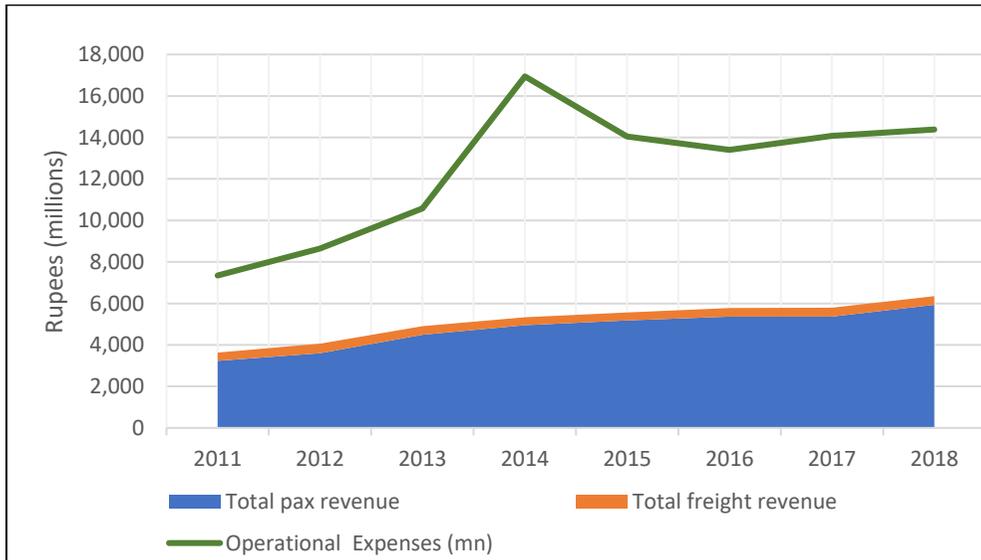
Source: Authors' illustration based on CBSL Report 2019 and Railway Performance Report 2018

Figure 3: Train punctuality
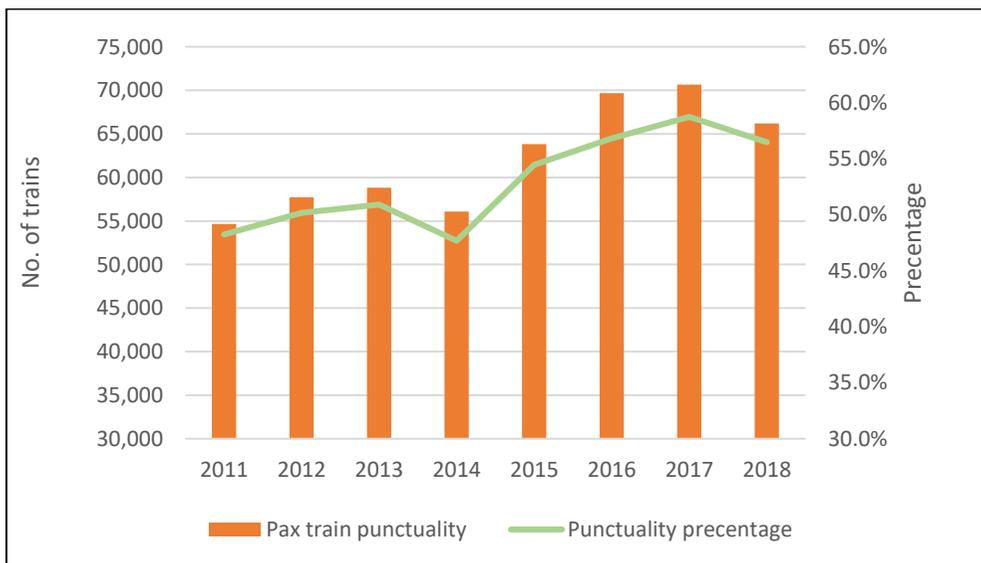
Source: Authors' illustration based on CBSL Report 2019 and Railway Performance Report 2018

The punctuality of the SLR is averagely 55%, and it could be visualized in the Figure 3 above. Outdated technology, older train fleets (more than 65% of locomotives are over 30 years old), outdated signalling systems and non-rehabilitated rail tracks are also reasons for frequent delays. The freight model share is even less than 0.4% (in 2018, rail freight carriage is 1.9 million tons). Mineral oil and cement are the major commodities that are transported by trains and there is no intermodal rail freight transportation.

Further, there were many rail accidents recorded over the last 5 years. Derailments, unsafe level crossing, overcrowded trains along with other sociological factors such as pedestrian behaviour (negligence) and erratic driving are the main causes of accidents. Figure 4 depicts the accidents and deaths involving railways during the last few years.

Figure 4: Railway accident (Deaths and Injuries)
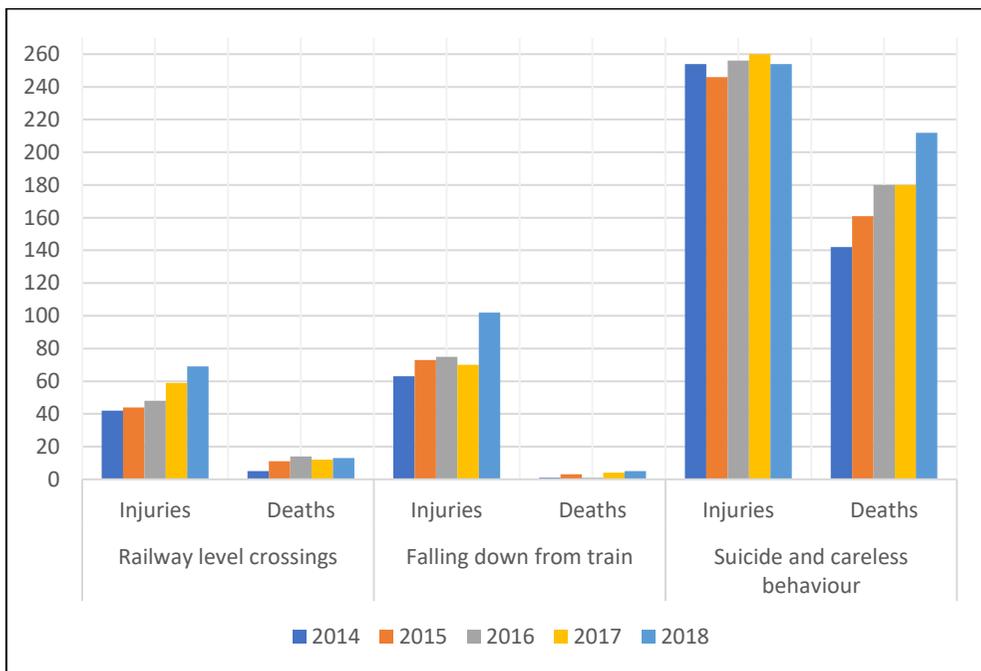
Source: Authors' illustration based on CBSL Report 2019 and Railway Performance Report 2018

Key issues and the root causes impacting the performance of Sri Lanka Railways

The 'Nvivo' software was employed to analyse the data collected from the Delphi method-based interviews and to determine SLR's key issues and root causes. By taking the highest frequent words from transcripts and then building parent nodes and child nodes by the software to count the relevant number of references, the root causes impacting the performance of Sri Lanka Railways were identified (refer to Annexure - B).

Pricing in SLR is observed as a key issue. Increasing reserved car ticket prices, having a separate pricing system for tourists, higher fine rates are the key issues identified by railway experts. According to the experts' opinions, outdated guidelines and the pricing system for the land properties should be changed. Further, a higher operational cost of running a train is a continuing issue with SLR. SLR must bear a high cost for the personnel emoluments and older train maintenance. Outdated signalling systems, lower traffic capacity, and frequent engine breakdowns are major causes of unreliable services. Adding to the major issues, political interference influences critical SLR activities such as construction projects, supplier evaluation as well as the recruitment process. Besides, lack of technical adaptation in the SLR operation remains a key issue. Lower level of digitalisation, and computerization of operational activities, older ticketing systems, poor usage of technology (like GPS, RFID) were stated by experts as technological issues. The connectivity of railways with other modes of transport and strategic nodes such as airports and seaports are a greater concern. There is no rail connectivity with seaport terminals which highly impacts the rail freight business in Sri Lanka. Besides, the rail stations are mostly located away from the main bus stations which inconveniences passengers and demonstrates lack of intermodal connectivity.

The experts view that SLR is unable to realise economies of scale in freight transport owing mainly to the non-existence of long hauls and non-existence of bulky transport. Therefore, due to double handling of operations, freight transport by rail might not be cost-effective for some commodities. The existing rail freight market is therefore limited to cement and petroleum. Rail freight business should be expanded to transport more varieties like containers, rice, flour, vegetable, and fertilizer. Industry experts viewed that, even though most of the warehouses are located nearby rail lines, there is no attractive business model and a mechanism to transport containers by trains. EU countries, Japan, Singapore, and most of the other ASIAN countries have developed their rail stations as commercialized hubs. Shops, retiring centres, bank facilities, and more relevant activities should be established in stations. Experts viewed that SLR has not attempted to improve such activities that could generate extra revenues. Thus, SLR has not benefited from value creation from its own property.

The most critical root cause for SLR administration complexity is the long procedures in assigning responsibilities. Bureaucratic structure of the organisation was also mentioned as a key issue. Outdated guidelines, procedures, and regulations in the procurements of rail equipment and mobile assets have led to lower the level of technological adaptation and performance in the industry. Furthermore, the procurement department faces difficulties in collaborating with other sub-departments and promptly fulfilling their requirements. Besides, the level of integration and collaboration with other public organizations is also in a weak position. External stakeholder collaboration such as with Urban Development Authority, Road Development Authority, Customs, and other

relevant authorities in the transport sector should be established before suggesting a railway reform plan.

**Reform Considerations for Sri Lanka Railways**

Ten major reform considerations were identified through the initial analysis of the AHP. All the considerations were prioritized by pair-wise comparison (Table 2). Sub-criteria were also mentioned as they clearly described the main criteria of the decision tree. AHP's second stage was employed to prioritize the main criteria (Figure 5).

Table 2: Scores for pairwise comparison for reform criteria

Ranking Criteria	Infrastructure	Service operation	Pricing	PSO	Cost	Agreement	Regulatory bodies	Administration	Market	Technology.	Priority Vector
Infrastructure	1.00	0.50	1.00	3.00	3.00	4.00	2.00	3.00	2.00	3.00	0.159
Service operation	2.00	1.00	2.00	3.00	3.00	3.00	2.00	3.00	1.00	5.00	0.190
Pricing	1.00	0.50	1.00	3.00	2.00	3.00	2.00	4.00	1.00	3.00	0.140
PSO	0.33	0.33	0.33	1.00	3.00	2.00	3.00	4.00	1.00	4.00	0.114
Cost	0.33	0.33	0.50	0.33	1.00	3.00	2.00	3.00	0.50	2.00	0.078
Agreement	0.25	0.33	0.33	0.50	0.33	1.00	0.25	2.00	0.50	2.00	0.048
Regulatory bodies	0.50	0.50	0.50	0.33	0.50	4.00	1.00	3.00	0.50	1.00	0.075
Railway Admin.	0.33	0.33	0.25	0.25	0.33	0.50	0.33	1.00	0.33	0.50	0.033
Market condition	0.50	1.00	1.00	1.00	2.00	2.00	2.00	3.00	1.00	3.00	0.119
Tech. concern	0.33	0.20	0.33	0.25	0.50	0.50	1.00	2.00	0.33	1.00	0.043

Source: Authors' illustration based on Survey data

Figure 5: AHP Decision Tree
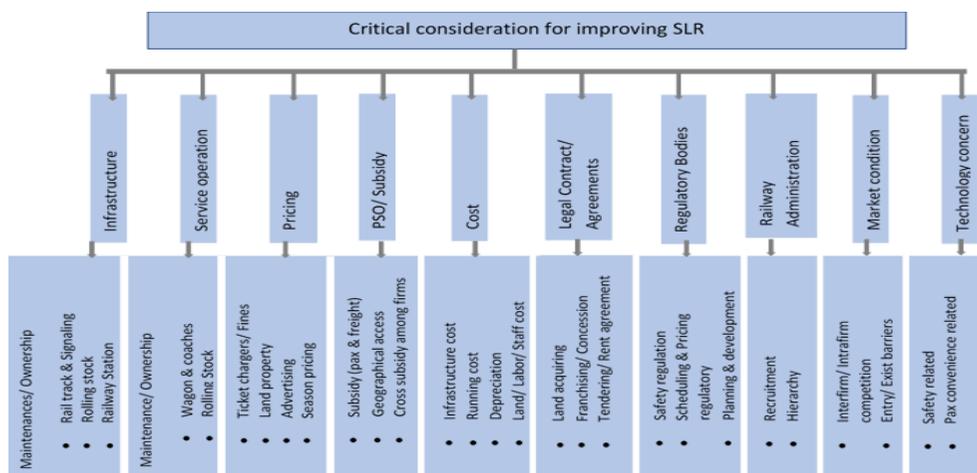
Source: Authors' illustration based on Survey data

Running service operations, infrastructure, pricing, and Public Service Obligations (PSO) received the maximum weight among others. Therefore, SLR needs to focus on such areas and change the existing policies therein. According to the AHP method; the critical ratio should be less than 0.1 to accept (Saaty, 1987). Thus, the results can be accepted due to the valid consistency ratio recorded as 0.089.

Based on the results of the Inter Quartile Range (IQR) and variance analysis, suitable rail reforms and policy initiatives were derived. Table 3 presents the final output of the determined policy statements, mean, median, variance and IQR. Most of the statements were accepted as they were developed by Delphi 01st round findings, and from the international experiences of rail reforms.

Table 3: Identified policy statements and IQR results

	Policy	Mean	Med	Var	S.d.	Min	Max	IQR
1	Restructuring the hierarchy and organization structure and reshape exists operational policy and infrastructure policy	1.50	1.00	0.57	0.76	1.00	3.00	1.00
2	Vertically separation between infrastructure and service operation	1.50	1.00	0.57	0.76	1.00	3.00	1.00
3	Government responsibility for the railway infrastructure and retaining the infrastructure ownership (If yes).							
3.1	*Rail track maintenance/ development, develop signalling system/ maintenance, stations maintenance, level crossing maintenance done by government*	2.25	2.00	0.79	0.89	1.00	4.00	0.75
3.2	*New separate department for strategic planning, infrastructure planning and technological improvement aspects*	1.63	1.50	0.55	0.74	1.00	3.00	1.00
3.3	*Introduce committee to check corruption in construction and procurement*	2.13	2.00	0.41	0.64	1.00	3.00	0.75
3.4	*Service guarantee policy apply for Infrastructure developments and procurement*	1.63	1.50	0.55	0.74	1.00	3.00	1.00
4	Retain the ownership of mechanical and technical departments with the government by introducing new policies. And service supply to the private operating companies.	4.38	4.00	0.27	0.52	4.00	5.00	1.00
5	Separate commercial activities from the long-term liabilities and establish new division to handle long term liabilities (Payment for excess labour after restructuring / accumulated debt payment / future debts)	2.25	2.00	0.50	0.71	1.00	3.00	1.00

6	Introduce new entity for the operations of commercialized the railway services	1.75	2.00	0.50	0.71	1.00	3.00	1.00
7	Horizontal separation and establishment of several divisions of service operation (Multiple products with separate accounts)	1.38	1.00	0.27	0.52	1.00	2.00	1.00
7.1	*Suburban / Long distance / Regional pax service/ goods / Special train as the multiproduct categories*	4.50	4.50	0.29	0.53	4.00	5.00	1.00
8	Opening rail network to 3rd parties (private sector) on track access fees with lower entering barriers (passenger transport companies involving)	1.75	2.00	0.50	0.71	1.00	3.00	1.00
9	Rolling stocks, wagon, coach leasing to the private sector	1.88	2.00	0.41	0.64	1.00	3.00	0.75
10	Opening rail network to the 03rd parties (pvt. sectors) for track access fees – freight transport	2.25	2.00	1.07	1.04	1.00	4.00	1.75
11	Accept cross subsidy in Government own multi product service operation	4.13	4.00	0.70	0.83	3.00	5.00	1.75
12	Network access from the competitive tendering process for the rolling stocks	1.25	1.00	0.21	0.46	1.00	2.00	0.75
13	Non-profit rail lines fully operated by the state-owned railway	4.25	4.00	0.50	0.71	3.00	5.00	1.00
14	Introducing an intermediate regulatory body to enforce rules, regulations							
14.1	*Licensing and certification, charging access fees, supervision of the quality of the service, tackle the conflict among rail operators*	1.50	1.00	0.57	0.76	1.00	3.00	1.00
14.2	*Independence safety regulatory body (by checking the condition of track and signalling & telecommunication, introducing technologies in safety aspects)*	1.50	1.00	0.57	0.76	1.00	3.00	1.00
14.3	*Implement separate body for Real estate management and retain owner ships with government (Develop land property, collecting rents, acting for illegal tenure)*	1.50	1.50	0.29	0.53	1.00	2.00	1.00
14.4	*Implement separate body for Real estate management and retain owner ships with Pvt sector*	3.88	4.00	0.41	0.64	3.00	5.00	0.75
15	New mechanism to end customer goods delivery by multimodal transportation. (By investing land freight carriages and handling equipment)	3.75	4.00	0.21	0.46	3.00	4.00	0.75

Scale   1 = Strongly agree   5 = Strongly disagree

Source: Authors' illustration based on Survey data

In the 2nd round of AHP, data were gathered from 8 experts for the IQR analysis, and Cronbach's Alpha was used to measure the internal consistency. The alpha value was within the acceptable range and recorded as 0.715.

Survey participants strongly agreed to reform the SLR hierarchy and re-organise the structure to mitigate the existing operational issues. Presently, SLR has a vertically integrated structure, and the expert group consensus was to vertically separate the ownership between rail service operation and below-rail infrastructure.

All experts agreed that infrastructure ownership should be with the public entity to be established, and not transferred to private entities. The main reason is non-profit routes may not be maintained properly by private rail companies. Therefore, the rail track maintenance, further development, and extensions, signalling systems, station maintenance as well as rail crossing maintenance should continue under the public sector. However, the private sector can be involved in freight rail infrastructure development. Rail track, freight handling equipment can be owned and operated by private firms.

At present, three different sub-departments deal with the technological aspects of operational moving assets (Motive Power), infrastructures (Way & Works) and signalling (Signal & Telecommunication). Sri Lanka Rail industry is not aligned with the current advanced rail technologies. Therefore, it is necessary to include a separate new department for strategic planning, infrastructure planning and technological improvement aspects which may function beyond the roles of the existing Planning Unit headed by a Director (Planning). Still, there is no mechanism to check the ratio between service level improvement and capital investment. Thus, it is mandatory to introduce such key performance indicators to measure economic returns.

Sri Lanka is not in a favourable position in the global corruption index. The index explains that the government establishments are corrupted more than the private institutions. A specialised "transport regulator" is a necessity to inspect and identify corruption in the construction and procurement processes while checking the quality. Quality and Cost-based Selection (QCSB) methods can be applied by the procurement unit for the supplier selection process. Yet, a service guarantee should be initiated as a new policy and it is essential to update guidelines and regulations for procurement of goods and services meanwhile focusing on the advanced technologies. All the technical sub departments (Mechanical, Way and Work, Motive Power, Signalling and Telecommunication) and Units (Planning, Data Processing) of SLR should be involved with the private sector in the form of Public Private Partnership as per the consensus of the expert panel. When it is completely government-owned, the labour productivity decreases and the quality of the service gets lower as there is no performance measurement.

Presently SLR is not a commercially oriented transport services provider, and the existing pricing and operational policies are not aligned with commercialization principles even

though there is a sub department (Commercial Superintendent Sub Department). According to the expert group consensus, commercial activities should be separated from long-term infrastructure related liabilities which are now coming under the government Treasury and managed under an organization with corporate orientation and principles. This requires reforming the existing SLR organizational structure. Long term liabilities such as accumulated debt payment, labour compensation after reforms (because the excess employees at present), land acquisition payment should be done through a separate entity which may also own and supply tracks and signalling. Experts viewed that horizontal separation and establishing several divisions of service operations (multiple products with separate accounts) and minimizing the cross-subsidy among multiple product units should be major considerations under reforms. However, the existing service categories are not adequate in the market and need to have more service categories to match the passenger demand. The vertically integrated model lacks responsiveness to the market demand and the organization has no concern over competition and on the improvement of the service quality in terms of comfortability, reliability, punctuality, and accessibility which are major parameters affecting the demand for passenger and freight rail services. Yet, through the vertical separation method, 3rd party operators should have access to the network by paying access fees. Experts' aggregate view favours introducing competition for both freight and passenger operations with low barriers to entry. The government's rolling stocks, wagon, coach and tanks can be leased to the private sector. The competitive tendering process can be applied while giving market access to passenger train operating companies. Therefore, running time, running distance, coach capacity, service quality, and other operational aspects can be considered as standards in the tendering process and in the performance evaluation. Non-profit route access can be given to private operators and the government may subsidise such operations to close the financial gap. Although the budgetary burden on the government continued to remain as in the vertically integrated department model of management and operation, the relative improvement in service quality, increased passenger demand, service modernization and reduction in bureaucracy justify the efficiency of the subsidy. The subsidy under the departmental model as at present was used to finance operating losses. Further, it is also possible to set up a publicly owned company under the vertically separated operational model in the network as found in some of the countries in the EU such as Sweden and Netherland (Asmild et al., 2009). However, granting public subsidies has a significant negative effects on the operational efficiency, as experienced by a full integrated railway department such as SLR while the greater managerial autonomy provided by reforms tends to increase the efficiency (Oum, Waters and Yu, 1999).

There should be an intermediate independent body for licensing, service quality supervision as well as to handle the conflict among operators. According to the consensus among experts, safety regulations, safety guidelines and maintenance of the infrastructure should be handled by a separate public entity. Such a government entity should have the autonomy to execute supervision.

Further, land property management and non- core land management should also be regulated by a separate government entity. Property development, collecting rents, acting for illegal tenure and non-core businesses can be regulated by that entity.

Table 4: Comparative analysis of major issues present in the SLR, and the degree of success experienced by other countries in resolving them through rail reforms

Major Issues Present in the Sri Lankan Railway system	Degree of Success in Fixing Issues after Railway Reforms							
	Japan	Sweden	Britain	German	France	Thailand	China	India
Chronic financial deficits, Ineffectiveness in collecting revenues, Provision of services at below marginal cost	M	M	M	M	L	L	L	L
Overmanning, Unionization, Resistance to change	H	M	M	M	L	L	L	L
Low productivity (Passenger Model share and Freight model share)	M	H	L	H	L	M	H	H
Less Infrastructure & services development in rural area	L	L	M	M	M	L	M	M
Decrease of freight transport	L	H	M	M	L	L	M	M
Low service quality/ Congested services / Services have failed to respond to need	M	H	M	H	H	L	L	L
Lack of competition	H	H	H	M	L	L	L	L
Lack of strategic commitment	H	H	M	H	L	M	L	M
Low managerial and technical Efficiency/ Low Productivity	H	H	M	H	L	L	L	M
PSO and subsidy to the passenger	M	L	M	M	L	H	M	H
High political intervention (recruitment process, tendering, etc.)	H	H	M	M	L	L	L	L
Less safety in railway operation (Intermediation authority to inspect safety, Obsolete tracks, obsolete trains, lack of maintenances, unsafety cross-sections, less technological usage, issues in signalling and telecommunication systems	H	H	M	M	H	L	L	L
Less consideration of Environment (electrification, innovation etc.)	H	H	L	M	H	L	M	M
Management issues in planning and operations, less integration among divisions, not defined responsibilities	M	M	M	H	H	L	L	M
Management of real estate management (Develop land property, collecting rents, acting for illegal tenure)	M	M	M	H	H	L	L	L
	H=7** M=6 L=2	H=9 M=4 L=2	H=1 M=12 L=2	H=6 M=9 L=0	H=6 M=9 L=0	H=1 M=2 L=12	H=1 M=4 L=10	H=2 M=6 L=7

Key: L = Less   M = Moderate   H = High   **The number is the frequency

Source: Based on (Beria, Quinet, de Rus and Schulz, 2012; Bogart and Chaudhary, 2012; Cartmell, 2016; Charanwanitwong and Fraszczyk, 2018; Fitzov, 2017; Gangwar and Raghuram, 2017; Holvad, 2009; Kopicki and Thompson, 1995; March et al., 2013; Mizutani, Smith, Nash and Uranishi, 2015; Nash, 2008; Ozkan et al., 2016; Yu, 2015) and *data from industry expert interviews.

A successful railway restructuring should be a process with clearly defined steps. Most of the countries typically took time for their rail reforms, and the time length mostly correlated with the objectives. For example, Sweden's first significant reform was carried out in 1988 and opened the rail market for competition completely by 2010. Therefore, Sri Lanka cannot expect to hastily complete rail reform within three-four years. India, China and Thailand still have not reformed their railway structures and all those countries follow the German model to some extent. A thematic analysis performed using literature diagnosed the degree of success of rail reforms in fixing then persisted issues in selected countries. Table 4 above comparatively presents persistent issues in SLR, and the degree of success experienced by other countries in resolving them through their rail reforms.

According to Table 4, a higher level of reform success in fixing issues was observed with Swedish and the German restructuring models. Hence, Sri Lanka may learn and formulate a reform model characterized with elements of a German-Swedish hybrid model. Sri Lanka Railways may explore the possibility of vertically separating "below" rail (track management) and "above" rail (operators of trains and rolling stock) – dividing the ownership between service operation and infrastructure. German and Sweden's railways keep infrastructure ownership with the government. SLR can continue to be the responsible authority for the rail tracks and their maintenance, further development, extensions, signalling systems, station maintenance as well as rail crossing maintenance. However, it is mandatory to improve rail tracks and upgrade signal systems before opening the market to private operators (like in UK, Sweden, and German). The reason can be that the private companies are not inclined to agree to frequent cancellations and delays. Many countries like Sweden, Germany, and UK have promoted voluntary retirement schemes, and seized the recruitment process to increase labour productivity. The same can be applied in Sri Lanka as well to ease the excess workforce burden. Further, most of the non-profit routes are run by government rail companies in Germany and Sweden. The same model is suitable for Sri Lankan context as there are several rural services in operation. Horizontal separation and creation of multiple service products can increase the competitiveness of the rail market. The efficiency levels of rail operation in countries with only vertical separation do not significantly differ from countries without reforms. Hence, horizontal separation should also be undertaken to raise the operational, and cost efficiencies (Cantos, Pastor and Serrano, 2012).

In addition, Mizutani et al. (2015) found that vertical separation only increases costs in a denser network. Further Friebel et al. (2010) confirmed that rail restructuring with multiple reforms in a package undertaken sequentially led to efficiency improvement. SLR also should lease moving assets, passenger, and freight services to private sector operators and increase the operational and cost efficiencies. A separate accounting method for commercial activities to minimize the cross-subsidy among multiple services should be implemented and that can enhance the operational efficiency as inefficient cost centres can be identified. This is more advantageous as a fully separated model, both

vertically and horizontally provides non-discriminatory access to the network and cost transparency (Asmild et al., 2009). The Government can explore the possibility of establishing a separate regulator to deal with matters such as real estate management, non-core asset management, infrastructure safety, train licensing, scheduling, resolving conflicts and inspecting the quality of rail service providers, strategic planning and infrastructure development and technological supervision. The government should commit considerable investments during initial stages of reform as the rail infrastructure should be developed sufficiently before the vertical separation.

CONCLUSIONS, RESEARCH LIMITATION AND FUTURE RESEARCH

The purpose of this paper was to identify key issues and root causes for the operational and financial inefficiencies of Sri Lanka Railways and elaborate on the best reform structure in the light of rail industry expert opinion and lessons learnt from world rail reforms. Literature on rail reforms undertaken globally were reviewed, and reform characteristics, models and outcomes were identified. Secondary data on SLR operations were descriptively analysed to identify financial and operational issues. A semi-structured questionnaire developed based on literature was used to interview twelve railway industry experts. Analytical Hierarchy Process method, content analysis, and policy Delphi method were the main techniques employed in the analysis. The outcomes indicated that a vertical separation of the ownership between rail service operation and rail infrastructure provision is suitable for Sri Lanka Railways. Given the existing operational and financial characteristics, lessons learnt from other countries and the industry expert's opinions, the German-Swedish hybrid model appeared the most appropriate model for railway reforms in Sri Lanka.

The study has a few limitations. The perspectives of public policymakers are not represented in the expert interviews. Micro-level analysis on different divisions of Sri Lanka Railways is needed to evaluate and identity suitable business and operational models. Research should be carried out on technological adaptability, local railway technology development, and establishing regulatory framework in the railway system. Railway land and property development, management and related socio-economic issues are also important topics for future research.

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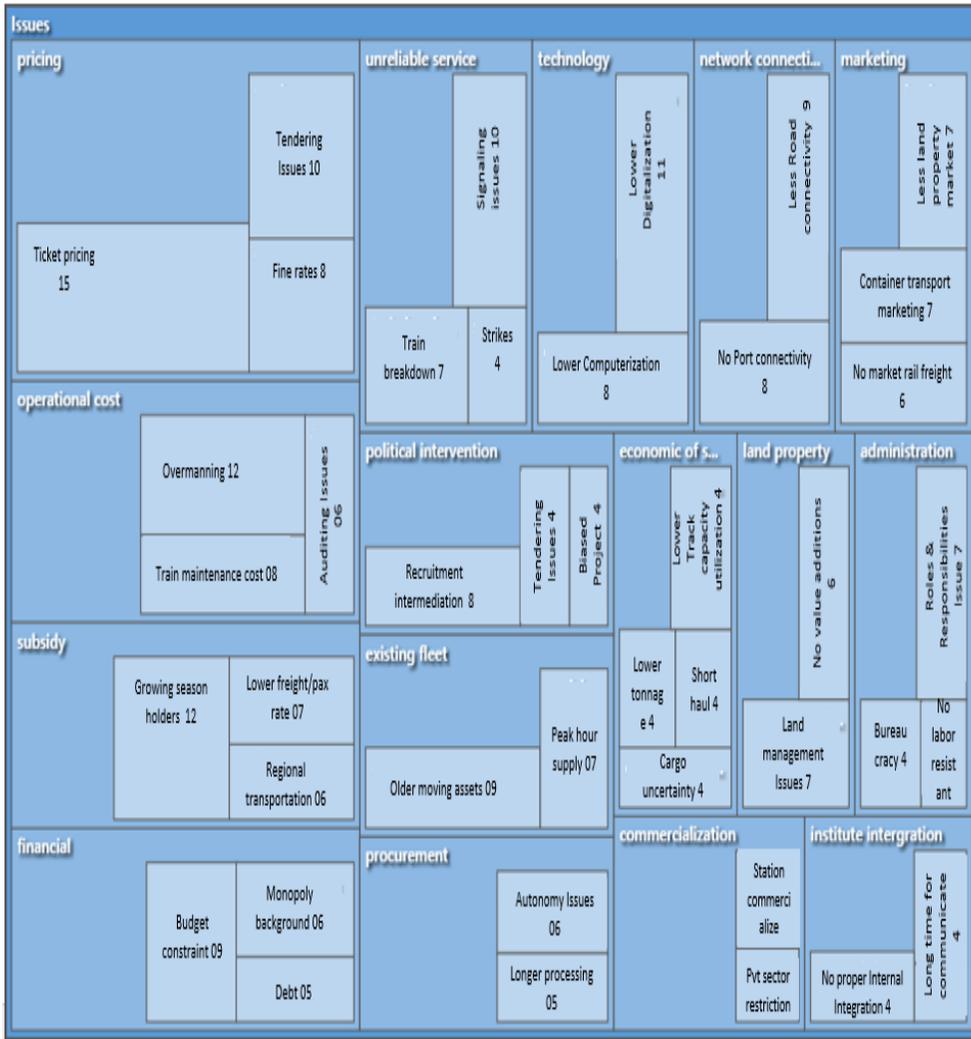
Annexure - A: Summary of the reform's review of selected countries in the world

Country	Operational ownership	Infra. ownership	Land management	Subsidy	Institutional arrangement	Labour
Japan	Vertical integrated and regional separated pax railway. 3 pax companies and 01 freight railway company under JRTT in Government Act	Private companies	A separate entity to manage the land property. Private sector for management.	Significantly reduced subsidy, Competitive tendering process for non-profit routes	Separate construction and safety regulatory bodies. Clearing groups for responsible long-term debt, separate assets and regulate employees. Established a research and development unit	The autonomic system with high labour utilization
Sweden	Vertically separated. Freight and passenger both owned by the state.	80% managed by state	A separate entity to manage land and stations. Fully owned by the Swedish Govt.	Competitive bidding when entering. Pax and freight subsidy reduced by 60% by 20 years	Separate institute for issue licenses and certificates of the register in ownership. Separate entity for safety reviews	Automated systems with high labour utilization
Britain	Vertical and horizontally separated. Franchised system for both freight and pax services.	Government control but private sector operators	Full owned by the government including value addition and marketing.	Competitive bidding when enter. Subsidy for pax train. Separate institute for handle subsidy.	An entity responsible for the safety, strategic planning, licensing, regulations, and investigations and economic regulations.	Pension obligation Semi-automated and labours
Germany	Vertical and horizontally separated. No cross-subsidy and completely separated accounting systems.	Government control but private sector operators	The State railway responsible for real estate and debts. Private sector for real estate management	Significantly reduced subsidy. The competitive tendering process for non-profit route	Independent entity for technical supervision- RegTP, the Federal Regulatory Agency. Separate entity for track maintenance and station maintenance.	Pension and high labour productivity

Country	Operational ownership	Infra. ownership	Land management	Subsidy	Institutional arrangement	Labour
France	Vertical integrated two bodies with regional passenger services to regional authorities	Government (a public authority)	A public authority to manage land and stations. Fully owned by the govt	A strong growth in subsidies per train km in the regional market	A public authority responsible for track improvement and development, network investment choices and financing, and setting and collection of track use tariffs/ Independent regulatory agency (ARAF) and a safety authority (EPSF).	Pension obligation Semi-automated and labours
Thailand	Vertical integrated. Lower private sector ownership	Government	A new public organization for management	Highly subsidy to the passenger and freight	Separate body for the safety inspection	Labour intensive
China	Vertical integrated. Lower Private sector ownership	Government	Government-owned and no separate institute for management	Subsidized for local passengers	Separate bodies for corruption investigation and commercial operations. A separate entity to setting standards for the service quality.	Moderate labour productivity
India	Vertical integrated. Lower private sector ownership	Government	Government-owned and no separate institute for management	Highly subsidy to the passenger and freight	Separate body for the commercialized purposes	Labour intensive and low digitalization, computerization, and automation

Annexure - B: NVivo output: Key issues and root causes of SLR

Source: Authors' illustration based on Survey data