Analysis of Trucking & Transportation Services Performance Factors: A Lean and Green Paradigm Shift

Gabriel Dan F. Fermazi, Cel Adriane Y. Lalo, and Marvin I. Noroña
School of Industrial Engineering and Engineering Management
Mapúa University
Manila, Philippines
gdffermazi@mymail.mapua.edu.ph, caylalo@mymail.mapua.edu.ph, minorona@mapua.edu.ph

Abstract

Lean & Green paradigms have been integrated into one concept, due to their similarities in terms of waste reduction and resource efficiency and sustainability. In the Philippines, there is an apparent lack of visible lean and green applications in transportation management with persistent recurring issues of truck congestion at the ports and heavy road traffic problems without truck ban, resulting in economic losses and GHG emissions. These considerations lead to an interesting question of how lean and green paradigms can improve the performance of freight transportation service providers in the country. The study aims to determine the significant lean and green factors that can be incorporated into performance measurement to improve the freight trucking performance in the Philippines. Results pointed to the perceived effects of factors under operational sustainability with lean operations and reduction of externalities as the most significant variables to improve freight trucking and transportation service performance.

Keywords:
Lean & Green, Operational Sustainability, Reduction of Externalities, Structural Equation Modeling

1. INTRODUCTION

Lean applications focused on improving efficiency & eliminating waste and green practices geared toward improving sustainability performance thru the reduction of environmental impacts of business operations have been implemented as separate programs in the past. However due to the shared goals of eliminating operational inefficiencies and green wastes, the combination of lean and green practices as a paradigm have been increasingly embraced with its great synergy towards the more sustainable businesses, improved environmental performance, and better process cost-efficiencies (Farias, 2019).

Freight transportation in the Philippines, is one of its major industries in the country, beset with many delays in deliveries due to traffic congestion thereby producing massive amounts of Greenhouse Gas (GHG) emissions (Odchimar, 2015). There has been a movement to solve said issue towards green sustainability (Mañalac, 2015) with the implementation of policies, risk assessment, and enforcing traffic rules & regulations (Bakker, 2017), but however, the country remained known for its horrible traffic management, and for its highest GHG emissions among the Asian countries (Palconit, 2019).

There is an apparent lack of visible lean and green applications in transportation management, more particularly in freight trucking services, in the Philippine setting with persistent recurring issues of truck congestion at the ports resulting from the long process of transferring products to the container trucks, and heavy road traffic problems resulting in delayed deliveries and increased carbon gas emissions (Bakker, 2017). These are factors that affect the sustainability and profitability of freight transportation service providers (Patalinghug, 2015). Which leads to the enviable question of how lean and green paradigms can improve the Performance Factors (PF) of Philippine freight transportation. In essence, putting in place a Performance Factors model that is anchored on lean and green supply chain management practices will greatly help the freight transportation industry in the Philippines in terms of sustainability and cost-effectiveness in the use of its resources and in meeting the needs of their customers.

This research aims to achieve the following objectives:

1. To assess the current freight transportation performance system and identify the areas of lean and green applications in freight transportation.
2. To determine the significant factors affecting lean-and-green performance in freight transportation management in terms of sustainability & profitability.
3. To recommend a lean and green performance management framework for freight transportation service providers.

The results of the study are expected to benefit the freight transportation providers who will have a model as a basis for Performance Factors and improved management. The freight transportation industry will also benefit from the study in terms of sustainability reporting and industry performance monitoring. Additionally, the country will stand to gain from lean-and-green practices of the entire industry in the long term in the light of its pursuit of environmental improvements in gas emissions and traffic management. The conduct of the study will adopt as its unit of analysis the freight transportation operators based in Manila, serving the trucking needs via shipments through the Manila Port as freight trucking operations generally represent the current state of freight transportation.

2. METHODOLOGY

The study aims to determine the significance of lean and green paradigms that can improve the Performance Factors of Philippine freight transportation. The study will adopt the following framework as its logic in achieving the aforementioned objectives.

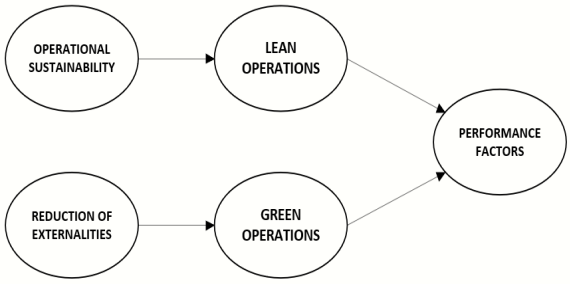

Figure 1. Conceptual framework of Performance Factors model

Operational Sustainability (OS) and Lean Operations (LO) have a very close relationship, as one of the Lean operations' core concepts is sustainability. Lean operations meet a diverse range of sustainability outcomes beyond the environmental benefits (including supply monitoring, transparency, workforce treatment, and community engagement). Therefore, lean operations & operational sustainability are interlinked (Piercy, 2015).

H1o: No significant direct effect of Operational Sustainability to Lean Operations.
H1a: Operational Sustainability has a significant direct effect on Lean Operations.

Reduction of Externalities (RE) is, by definition, reducing negative externalities such as pollution and waste, created from production, consumption, or transportation. The introduction of tax increases the private cost of consumption or production, and ought to reduce demand and output for the good that is creating the externality.

H2o: No significant direct effect of Reduction of Externalities to Green Operations.
H2a: Reduction of Externalities has a significant direct effect on Green Operations.

Green Operations (GO) is interlinked with Performance Factors, where having performance measured can help drive and show positive improvement in environmental impact. In the context of SCM, GSCM aims to integrate environmental thinking into SCM. Thus, GSCM can contribute to sustainability performance enhancement (Chin, 2015).

H3o: No significant direct effect of Green Operations on Performance Factors.
H3a: Green Operations has a significant direct effect on Performance Factors.

The implementation of Performance Factors in Lean Operations has been gaining more attention, whether developing a KPI Tree for production systems (Ante, 2018), or an integrated performance measurement framework for lean organizations (Sangwa, 2018), thus their relationship should be studied upon.

H4o: No significant direct effect of Lean Operations on Performance Factors.

H4a: Lean Operations have a significant direct effect on Performance Factors.

The lean and green operations, when interlinked together, have proven to have positive contributions towards sustainable, environmental & operational performance (Inman, 2018). And while many companies intend to move towards this, it is challenging to implement, and therefore, a performance factors framework is needed to effectively implement & integrate these operations to improve their performances (Cherrafi, 2017).

2.1. Structural Equation Modelling

Structural Equation Modelling (SEM) tool was used for assessing the significance of the performance factors of freight trucking services under study, related to paradigm shifts toward lean and green, improvement of overall sustainability and enhancing the cost-effectiveness in delivery of products delivered to its clients. The resulting model would contain the factors with a high level of significance that have strong and direct relationships with constructs defined in the conceptual model. The benefit from the resulting model would be in terms of focusing on where the lean and green initiatives should be emphasized for performance monitoring and continual improvement by transportation service providers.

In this study, SPSS AMOS software were used to assess the scores gathered from the online survey questionnaire using a Likert scale to weigh on the agreement on the relationships among latent and manifest variables as hypothesized. By obtaining the highest valued variable(s) from the model, it is considered significant and affects to other connected variables. From AMOS software, there are more possibilities that one of the variables can have the highest score to be considered as significant to "Performance Factors" that the company can focus on.

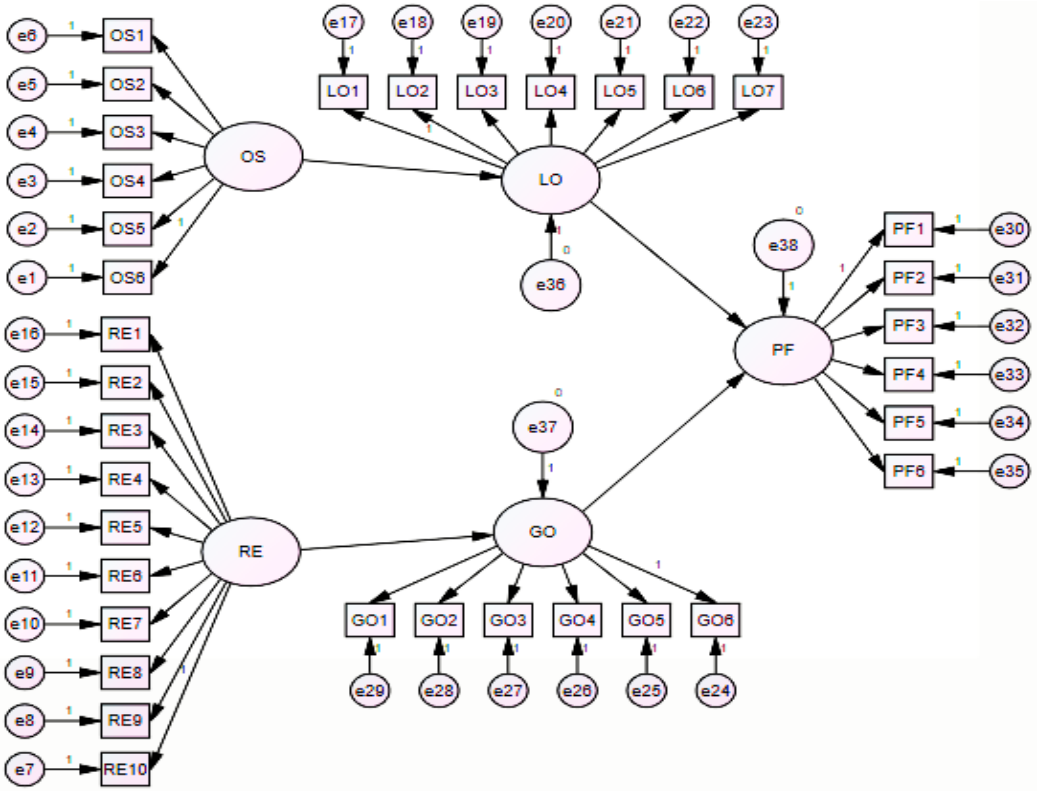

Figure 2. Operational Framework (with coded questions per construct)

Table 1. Summary Table of Related Literature for Performance Factors

Author	Title	Factors	Findings
Piercy, N.	The relationship between lean operations and sustainable operations.	Operational Sustainability	The paper shows that lean operations meet a vast range of sustainable possibilities beyond environmental advantages. It also specifies the overall policies, procedures, resources, and strategies for implementation of sustainable operations management (OM).
Ranieri, L.	A Review of Last Mile Logistics Innovations in an Externalities Cost Reduction Vision	Reduction of Externalities	Based on the Systematic Literature Review (SLR) method, the innovative contributions are classified into five main categories: innovative vehicles, proximity stations or points, collaborative and cooperative urban logistics, optimization of transport management and routing, innovations in public policies and infrastructures.
Garza-Reyes, J.	Improving Road Transport Operations using Lean Thinking	Lean Operations	The article provides insight into implementing Lean concepts in Road Transportation, by creating a tool that effectively plans a company's routes to reduce waiting, excess movement and other road wastes.
Kuo, S.	Determinants of green performance in container terminal operations: A lean management	Green Operations	The implementation of Green Operational Practices (GOPs) showed that it positively influenced green operations, green behavior & green performance. Green climate positively moderated the effect of lean management, green behavior, and green performance.

Table 1 above explained the basis for the factors chosen under study in view of having a lean and green paradigm shift in analyzing transportation service performance toward the provider's long term benefits and competitive advantage.

2.2. Data Gathering

The online survey respondents came from 400 operators and owners of freight trucking service providers accredited by the Philippine Ports Authority and included in the latter's official website; a sample size sufficient to have a good result in AMOS. The SEM will have 5 latent variables focusing on the Lean & Green paradigms & Performance factors. Table 2 explains the latent variables, the relevant number of manifest variables in the form of question codes, and the subsequent brief description of each code.

Table 2. Latent variables of Performance Factors

Latent	Description	Question code of Manifest	Description
Operation Sustainability	To determine the different factors that can be sustained efficiently, while maintaining the performance of operation management in freight transportation.	OS1-OS6	OS1 = Profit/Cost Sustainability. OS2 = Fleet Management. OS3/OS4 = Inspection and maintenance of equipment OS5/OS6 = Scheduling
Reduction of Externalities	Aims to minimize the potential externalities in order for the employees to perform well & to reduce costs.	RE1-RE10	RE1/RE2 = Constraints of eliminating transportation waste RE3/RE4 = Reducing GHG emissions

			RE5/RE6 = Nodes/ Channels RE7/RE8 = Road connection RE9/RE10 = Digitalization
Performance Factors	To assess the effectiveness of key factors by measuring performance, focusing more on Lean & Green performances.	PF1-PF6	PF1 = Organizational performance PF2 = Setting of standards PF3 = The life cycle assessment of the process of freight industry PF4 = Lean Performance PF5 = Green Performance PF6 = Holistic Lean & Green Performance
Lean Operations	To determine the effectiveness of the overall Lean Operations.	LO-LO7	LO1/LO2 = Reduction of distribution of routes LO3 = Availability of resources LO4/LO5 = Reduction of cycle time LO6/LO7 = Frequency of efficiency
Green Operations	To determine the effectiveness of the overall Green Operations.	GO1-GO6	GO1-GO3 = Green operational practices (GOPs) GO4 = Green climate GO5 = Green behavior GO6 = Controlling pathways

3. RESULTS AND DISCUSSION

3.1. Gaps

The first objective was to assess the current freight transportation Performance Factors process and/or system in the Philippines. Operations in trucking begins with the conversation of broker to operator, whether there is an available truck for a specific booking of deliveries such as equipment, materials, etc. Once the operator confirms the availability of their truck(s), they will immediately inform the dispatcher to get the documents to be signed. The broker provides the documents' corresponding gate pass and booking number, so the operator can begin the loading of containers.

After acquiring the relevant documents, the dispatcher goes to the operator, and the operator will validate the bookings by the clients, such as the number of wheels of the chassis, so that the chassis can carry the weight of the container and its contents. With the money and documents in hand, the helper, along with the mechanic, will be focusing to attach the relevant chassis to the truck itself. The final inspection of the vehicle starts before beginning the operation. The truck leaves for the port. A set of inspections happens in the port before getting the containers. Once the container is already settled & locked on to the chassis, the truck driver and helper will proceed to deliver the container to the clients. Once they arrive at their destination, unloading of the container's contents begins, and inspection of goods. Once the documents are cleared by the client, they return to the operator.

Goods are still received, damaged or not. If damaged, there is a return policy, but on a later date, and depends on the client and distributor. Trucking companies are usually excluded from the costs, unless they incurred the damages themselves. Once they meet up with the operator, they will hand over the signed documents that indicate the items have been delivered according to the time, quantity, & quality (undamaged/ good condition) delivered to them. The operator will then be ordering them to return the container to the port to make it official that their duties are done, and will be on standby for the next delivery. Payment will be depending on the distance and/or the items delivered, and the broker will notify the truck operators that the clients already paid the services of the trucking company.

Table 3. Gaps/ Pain Points of the process

Gaps/ Pain points	Description
Broker signs documentation	The delays of deploying the booking number and the gate passes that it takes longer to process than usual. Some trucking companies are beginning to

	implement online bookings, whereas some operators are still using pen and paper practices.
Loading/ Unloading of containers	There is a long line of trucks to & from the port, creating congestion. Finding the correct container takes time, and also if the container & chassis are compatible. Sometimes, during the delivery process, it is the warehouse design where there is no truck bay or the warehouse is only at ground clearance, which results in more time wasted. Or due to bad facility design, there is a long line of trucks on the road. It can be time consuming during the unloading process of containers.
On the road	Due to truck ban, restricted truck lanes, the need for barangay clearances, whether or not trucks can pass through certain streets, and receiving time windows of delivery, this results in a tight timeline for trucks to move around. Oftentimes, trucks wait outside of city roads during truck bans, waiting near highways or at the warehouse.
Miscommunication	The dispatcher usually gets the documents cleared either late, or gets it done early but doesn't inform the other relevant parties. This results in being late or delayed in deliveries, and is a wasted effort of resources. There is also the case of misinformation, where the dimension or weight is wrong, or has not been informed.
State of trucks	Most freight trucks here in the Philippines are old, second hand, diesel-fueled, and have been converted from right-hand side to left-hand side compartments. These refurbished old models are already a high contributor to GHG emissions, noise pollution, road damage & traffic. This goes without saying, but truck operators should upgrade or buy a new fleet when possible, however, for most truck operators in the Philippines, it is too expensive to afford a brand-new truck. And not only that, but they would have to buy new equipment that is compatible with the new truck.

Based on observation & verified through interviews, there are pain points in the holistic delivery process, or in the operations of trucking companies, such as the delays of deploying the booking number and the gate passes that it takes longer to process than usual. Some trucking companies have begun to implement online bookings, whereas some operators are using pen and paper practices.

Most of the delays are in the Manila port, where there will be a new delivery, but the employees are still in line to return the container, and it can be a potential profit loss to the operators. GHG emissions in the port or the trucking area, is difficult to work in since the emissions are harmful to the well-being of the employees, and there can be reduced visibility at times, due to muffler testing.

In the Manila port, documentation takes longer at the South Harbor, where international goods come and go. This is due to the Customs at the South Harbor, where cancellation happens often, and the delivered weight cannot be accommodated, which results in delays.

Another pain point is miscommunication, where the dispatcher usually gets the documents cleared either late, or gets it done early but doesn't inform the other relevant parties. This results in being late or delayed in deliveries, and is a wasted effort of resources. There is also the case of misinformation, where the dimension or weight is wrong, or has not been informed. An example of this, is where the distributor sent x number of boxes, but did not include the net weight of the boxes, which at times, can go over the weight limit of what the truck can handle.

Route optimization is a must now, and it is becoming ubiquitous for truck drivers to have GPS tools to avoid traffic jams, eliminate unnecessary fuel waste and to fulfill their deliveries at the shortest time possible. However, due to truck ban, restricted truck lanes, the need for barangay clearances, whether or not trucks can pass through certain streets, and receiving time windows of delivery, this results in a tight timeline for trucks to move around. Oftentimes, trucks wait outside of city roads during truck bans, waiting near highways or at the warehouse.

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3.2. Hypotheses Testing and SEM Results

The second objective is to identify the areas of lean and green applications in freight transportation management and to determine the significant factors affecting lean-and-green performance. The initial run of the SEM model shows the initial results of the latent variables are not significant enough. Through further testing, we have achieved significant results with each latent variable. Below are the results of hypothesis testing:

H1. Perceived significance of Operational Sustainability to Lean Operations on the effects towards Performance Factors.
Based on the final result of the model, Operational Sustainability has a significant effect with Lean Operations reaching its suggested cut off values of ($\beta = 0.87$, p-value = 0.001).

H2. Perceived significance of Reduction of Externalities to Green Operations on the effects towards Performance Factors.
Based on the final result of the model, Reduction of Externalities has a significant effect with Green Operations reaching its suggested cut off values of ($\beta = 0.810$, p-value = 0.001).

H3. Perceived significance of Green Operations to Performance Factors.
Based on the final result of the model, Green Operations has a significant effect with Performance Factors reaching its suggested cut off values of ($\beta = 0.267$, p-value = 0.275).

H4. Perceived significance of Lean Operations to Performance Factors.
Based on the final result of the model, Lean Operations has a significant effect with Performance Factors reaching its suggested cut off values of ($\beta = 0.985$, p-value = 0.001).

From the results, Operational Sustainability and Lean Operations have a significant effect towards improving the Performance Factors of the trucking companies in achieving their goals ($\beta = 0.87$, p-value = 0.001). It is also shown in the results that most of the respondents needed to have their operations to be more efficient, so that every transaction was delivered according to their process and to their goals. Improving the performance of the company is crucial, and to achieve this, they need to meet the company's factors, with proper implementation of Lean thinking (Villarreal, 2016).

Observing the results, Green Operations ($\beta = 0.267$, p-value = 0.275) can be improved with the contribution of Reduction of Externalities ($\beta = 0.810$, p-value = 0.001), which shows a positive environmental impact it has for the company. From observing the survey, respondents do want their companies to have a more positive and greener environment, through reducing GHG emissions and other externalities.

We achieved Green Operations with relatively poor results in comparison ($\beta = 0.267$, p-value = 0.275), which shows that there is a need for improvement. Trucking companies should vastly reduce their air and noise pollution, and implement Green Operational Practices, in their company, whether as a green climate for the office, or green behavior for each individual.

Lastly, Performance Factors has a significant effect with Lean Operations ($\beta = 0.985$, p-value = 0.001). Based from the results, some companies are not yet achieving the optimal efficiency, or are satisfied with being efficient enough for their clients, as well as maintaining decent standards for their performance metrics.

Table 4. Initial parameter estimates & goodness of fits

Measure	Initial Parameter Estimates	Suggested Cut-Off	Suggested by
IFI	0.632	> 0.75	Wulansari, 2019
TLI	0.608	> 0.70	Cheung et al, 2004

NFI	0.624	> 0.75	Bril et al, 2017
CFI	0.632	> 0.70	Bril et al, 2017

Table 4 shows the initial parameter estimates from the initial run of the SEM Model, that is not satisfying the suggested cut off for Performance Factors.

Figure 3 shows the final improvement and the relationship of the model in each latent variable and its corresponding indicators. This also explains the significance of each latent variable, which can be observed from their p values, where 0.05 and below is considered acceptable (Bril, 2017).

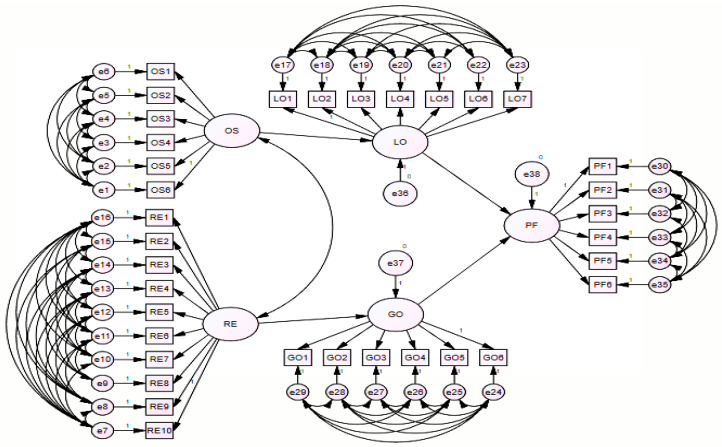

Figure 3. Final Structural Equation Model for Performance Factors

Table 5. Final Parameter Estimates and Goodness of Fit

Measure	Initial Parameter Estimates	Final Parameter Estimates	Suggested Cut-Off	Suggested by
IFI	0.632	0.774	> 0.75	Wulansari, 2019
TLI	0.608	0.710	> 0.70	Cheung et al, 2004
NFI	0.624	0.766	> 0.75	Bril et al, 2017
CFI	0.632	0.773	> 0.70	Bril et al, 2017

Given the suggested cut off, the initial and final SEM model with its indices in Table 5, IFI is considered as a good fit to the model which is IFI = 0.774 > 0.75 (Wulansari, 2019). As for the suggested cut off of TLI, it surpassed its cut off at TLI = 0.71 > 0.70 (Cheung, 2004; Shah, 2006). NFI passed its suggested cut off at NFI = 0.766 > 0.75 (Bril, 2017; Sanislow, 2002; Wulansari, 2019; Shah, 2006). Lastly, CFI reached its cut off at CFI = 0.773 > 0.70 (Bril, 2017; Sanislow, 2002; Cheung, 2004; Wulansari, 2019). Therefore, the model is considered to be a good fit.

Table 6. Direct effect, indirect effect, & total effect of path analysis

Number Path	Direct	P-Value	Indirect	P-Value	Total Effect	P-Value
1. OS > LO	0.807	0.001	No Path	-	0.807	0.001
2. OS > PF	No Path	-	0.796	0.002	0.796	0.002
3. RE > GO	0.810	0.001	No Path	-	0.810	0.001
4. RE > PF	No Path	-	0.216	0.276	0.216	0.276
5. LO > PF	0.985	0.001	No Path	-	0.985	0.001

6. GO > PF	0.267	0.275	No Path	-	0.267	0.275

Table 6 summarizes the direct, indirect and total effect of each path showing that OS had a significant direct effect with LO ($\beta = 0.807$, $p = 0.001$). Knowing the direct effect of OS with LO, it would imply that improving efficiency directly affects the overall operations towards a Lean paradigm, such as, consistent maintenance & reduction of unnecessary processes. OS also has a significant indirect effect with PF ($\beta = 0.796$, $p = 0.002$) and LO has a significant direct effect with PF ($\beta = 0.985$, $p = 0.001$), which implies that improving efficiency will indirectly lead to an increase in performance in a Lean paradigm.

The model indicates that RE has a significant direct effect with GO ($\beta = 0.810$, $p = 0.001$), which implies that reducing harmful and wasteful processes promotes a cleaner environment overall process. There is a significant indirect effect of RE with PF ($\beta = 0.216$, $p = 0.276$) and GO has a significant direct effect with PF ($\beta = 0.267$, $p = 0.275$), implying that a cleaner environment promotes an increase in performance in a Green paradigm.

In summary of the overall effects of each path known, LO, RE and OS have the most significant total direct effect towards PF, with OS & LO as the most significant latent variables to PF. This can be backed up by the many trucking companies who are in the process or have implemented such measures in improving their company's performance, lean-wise (Garza-Reyes, 2016). RE has the second highest direct effect ($\beta = 0.810$), which can be observed in reducing transportation wastes in various articles (Villareal, 2016). However, GO has the lowest direct & total effect overall from the results, which indicates that environmental PFs are not being met, and needs to be improved the most (Franchetti, 2016). T

Accordingly from the assessment of the freight trucking process, yielding gaps and pain points and from survey responses, improvements in the area of green operations are thus needed in order to have a green paradigm shift, that sustain operations efficiency while improving positive environmental impacts.

Lastly, a lean and green performance management framework would be desirable that is anchored on Lean & Green concepts but tailor-fitted for the trucking service companies in the Philippines. A combined platform of Lean & Green implementation would entail metrics and targets attuned to the nature of trucking services and operations consistent with the overall organizational goal(s) of the transportation firms. Lean, at first, will focus on operations efficiency, eliminating waste in resource usage in the conduct of providing services, and equally, Green will center on elimination of wastes in terms of emissions and inefficient resource utilization. As such, the latter will require standards and performance targets in reducing GHG emissions and carbon footprint. Reference frameworks like, but not limited to, KPI Tree (Ante, 2018) and Performance Map (Kurdve, 2013) can incorporate the performance factors found significant from the SEM model, namely, LO, OS and RE, as an integrated platform toward Lean & Green paradigm shift that encompasses the economic, environmental and social dimension of monitoring and reporting the sustainability performance of freight transportation service providers.

3.3. Improvement Measures

Table 7. Gaps/ Pain points with improved measures

Gaps/ Pain points	Improved Measures & Activities	Relationship	Benefits
Broker signs documentation	Transition towards online booking, Proper implementation of releasing of booking passes on online services.	OS directly affects LO.	A smoother & faster experience for more trucks to accommodate.
Loading/ Unloading of containers	Organizing containers by container dimensions, and proper facility planning.	OS directly affects LO.	Easily find & load containers, and to have an intuitive facility design for easier loading/unloading.
On the road	Operator must provide the relevant clearances to drivers. Another suggestion is installation of waiting areas across NCR & entry points into NCR.	OS indirectly affects PF.	Easier access through streets that require clearances. The installation will provide shelter areas for trucks to wait out truck bans or congestion.

Miscommunication	Implementation of an online receipt system that encodes the specifics needed for delivery.	OS directly affects LO & indirectly affects PF.	Provides more accurate details on the specifications of the delivery so that the operator can accommodate the needs of the clients – ex. Correct weight for the corresponding container.
State of trucks	Installation of catalytic converters. Stricter inspection & maintenance of trucks. Encouragement of drivers who become efficient in their practice.	RE directly affects GO.	Reducing GHG emissions, promoting a greener environment & rewarding sustainable behavior.

It is common knowledge that companies should be as efficient as possible, whether in cutting down time or improving a particular part of the process, but existing trucking environment is not safe for people to work in and might reduce their overall performance due to health risks. In the truck operator's perspective, green operations are not profitable to them, and so long as the truck is in good condition, green operations will do little to contribute to their business.

Based on the observation on truck operators, the first four gaps are the representation of the lack of implementation of lean paradigm; where it is designated under OS, and due to their direct relationship, LO too. The last gap, the state of the trucks, represents the absence of green paradigm, where it is designated under RE, and due to their direct relationship, affects GO also. Therefore, if these gaps are not attended to, it lowers efficiency (representing OS) and increases GHG emissions (representing RE), and negatively impacts the subsequent latent variables. The following are measures and solutions that is recommended to improve the latent variables positively.

Truck operators should transition towards online booking & proper implementation of releasing of booking passes on online services, so it becomes more convenient for the relevant parties and provides a smoother, faster transaction. Operator must provide the relevant clearances to drivers. Another suggestion is installation of waiting areas across NCR & entry points into NCR.

Based on the results of the SEM, it is recommended to applying the lean and green paradigms to the trucking operators in Metro Manila, such as setting up a dedicated area for the trucks, and to departmentalize the workforce and the facilities, and to have a proper ventilation system installed. This is to improve the truck companies' environment. Having a designated place for vehicles and employees can increase the efficiency of their performance, whereas some trucking company areas have only one place for all its equipment, employees, and vehicles, where operations happen in a small space. Expanding or proper allocation of its space can help, where there will be only places for employees to work, and the flow of entering and exiting trucks is unhindered. Furthermore, organizing containers by container dimension, proper facility planning for easier loading/unloading and installation of an online receipt system that encodes the specifics needed for delivery should be implemented at the Manila Port. This would help find & load containers easily for the trucks, provide an intuitive facility design for easier loading/unloading & less waiting time, and provides more accurate details on the specifications of the delivery so that the operator can accommodate the needs of the clients.

The companies should be focused on how to reduce their GHG emissions. One solution is to install catalytic converters. As there are already emission inspections in place, it is a matter of enforcement. A truck's prescription period should not be roadworthy after 15 years of use, and the government should enforce phasing out old trucks, and have an incentive plan in place for operators to buy new trucks. Also, a regular truck & emission inspection should also be enforced. Furthermore, trucking companies should implement an inspection of equipment such as chassis, trucks, etc., at the start and end of every shift, and before and after every delivery. This shows that not only the trucks, but also all relevant equipment is working daily, and if damaged or used in any way, should be taken note of and maintained. Inspection reports should be passed on to who oversees the next shift. On a greener perspective and aside from the government, truck companies should encourage and reward drivers who become efficient in their practice.

The recommended measures should be incorporated or heavily considered into formulating the recommended lean and green performance management framework. In a holistic view, the government should consider other solutions other than truck ban, such as providing freight-only roads or truck coding, a similar practice with the existing car coding, but with certain sizes of trucks & chassis allowed on the road on certain times.

4. CONCLUSION & RECOMMENDATION

Freight transportation in the Philippines plays a big role in the economy and the daily needs of people, supplying foods and beverages, materials and other essentials and goods. The study shows an insight into the local freight transportation companies and their current standards, which can be inefficient and leave high amounts of GHG emissions in the environment (Mejia, 2016), and to give the possibility for the implementation of Lean & Green concepts.

Results of the study pointed out the importance of adopting the significant factors out of the SEM model for performance measurement with metrics and targets not only to improve cost-efficiency but as well achieve a better green operations performance. The Structural Equation Model attained an acceptable model fit, with a degree of accurately assessing the current situation of the local freight transportation industry. Indeed, 46.3% of the survey respondents that have not yet implemented Green Practices in freight trucking operations, hence a need for bolstering awareness of the green concepts and sustainability practices. With this, it was noted that the pending law on the environmental tax on GHG emissions from trucks as an initiative to reduce CO2 emissions, will also complement the private sector's pursuit of a sustainable performance bringing to the fore the social, economic and environmental aspects of sustainable development.

For future studies, a multimodal freight transportation sustainability framework can be an interesting research topic that will entail a stakeholder approach and a systems perspective that will cover more macro-environmental factors affecting port operations, rail freight and logistics trucking that will present a better reference model for the freight industry as a whole and for beneficial legislation and governance in view of a collaborative public-private sector involvement to advance the current state of the industry.

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BIOGRAPHIES

Gabriel Dan F. Fermazi is a B.S. in Service Engineering & Management graduate from the Mapúa University in Manila Philippines. He is a Lean Six Sigma Yellow Belt. His research interests include lean manufacturing and green production, product design and development, supply chain and logistics, and transportation management.

Cel Adriane Y. Lalo is a B.S. in Service Engineering & Management graduate from the Mapúa University in Manila Philippines. He is a certified Lean Six Sigma Green Belt. His research interests include lean manufacturing, service quality, operations management and sustainability.

Marvin I. Noroña is a faculty member of the Mapua University School of Industrial Engineering & Engineering Management and School of Graduate Studies. He earned his BSIE and MBA degrees from University of the Philippines and is completing his dissertation for a Doctor in Business Administration degree at the De La Salle University. Apart from the research and teaching, he is into management consulting and training in the areas of sustainability, supply & operations management, production & service systems improvement, strategic planning and management, lean six sigma, and design thinking.