GREEN LOGISTICS AND SUPPLY CHAIN MANAGEMENT EFFECTS ON GREEN READY MIX CONCRETE (A CASE STUDY OF FACTOR FOR ORDER FULFILMENT)

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ABSTRACT

There are indications from past literature reviews that there is a lack of satisfactory and acceptable development of green logistics and supply chain management of ready mix concrete to the site where it is needed. Likewise, As a result of the importance of the environment is more acknowledged, the connection between environment and business management activity is getting extra significant. Meaning that, the factor of the relationship between business management and environment is very essential for acquiring international competitiveness irrespective of the size of the organization such as Construction sector. In the situation that the impact of the environmental concern is becoming larger along with the growth of the organization's social responsibility, small and medium organization such as any category of construction organization can be no exemption. Although their competence to handle environmental difficulties is weak as a result of more susceptible management circumstances than those of conglomerates, environment management for synchronization between environment and economy has become a significant charge to them. As a matter of fact, the environment management by organization such as the construction industry, has gone through the extensive transformation to what can be termed product-centred environment management, which embraces the thought of the complete procedure of green concrete production, logistics and supply management from the past construction industry's process-centered environment management since the late 90's, and consequently conglomerates have staged a foremost role in emphasizing the interest in the development of environment-friendly products. This paper take a critical look at the impact of green logistics and supply management of green ready mix concrete by adopting a dynamic model of the order fulfilment of green concrete supply. The result reveal that there is more environmental safety, less time wastages and cost effective.

Keywords- Green Logistics and Supply chain management, green ready mix concrete, construction industry, Order fulfillment.

Introduction

Environmental sustainability has been getting enormous academic and industry consideration in recent years. The challenges of Increasing carbon emissions and the connected global warming have been raising frequent inquiries on the struggles necessary to make companies more sustainable environment. In a globalized world, where business is getting progressively more concentrated, transportation of products over long distances is a certainty. Increasing consumption, wealthier lifestyles and supply chain matters like higher levels of logistics and transportation organization have resulted in higher carbon emissions thereby floating important queries on environmental sustainability. On a similar basis, customers are becoming more environmentally cognisant and are creating procurement selections with an eye on the environmental friendliness of its elements. Good examples of this are environmental logistics (i.e goods moving shorter distances), utilization of environmentally friendly logistics modes (such as inland waterways) and environmentally friendly packaging selections (Yang et al., 2013).Hence this paper,look critically at the impact of green logistics and supply chain management relative to the order fulfillment of green concrete in the construction sector in Malaysia.

Resource exhaustion and a progressively harmful environmental affliction instigated by organizational production procedures have led many international regulators to enforce stricter regulatory policies. Lately, the implication of Green logistics and SCM has increased tremendously in all sectors of global industry. Quite a number of global organization and enterprises have already embraced Green logistics and SCM or are considering its adoption for such different reasons as reaction to various environmental legislation and regulation, enhancement of the image of their organization's brand, work revolution, and cost reduction. Although, the small and medium organization and enterprises are commonly unequipped with sufficient information and human resources to manage those environmental problems efficiently. Moreso, the majority of construction organization and small and medium subcontractors are feeling abundant pressure owing to the demands of the environment of their companies. While conscious of the obligation of Green logistics and SCM, they are complaining of the trouble in its practice as a result of the difficulties of cost, response time, burdensome reporting, ICT and the lack of understanding of the matters connecting to the environment.

Green logistics and supply management have its basis in the duo of environmental management and supply chain management literature. The word green constituent to supply chain management comprises of addressing the effect and union between the natural environment and supply chain management. The contents, scope and definition of sustainable supply management ranged from sustainable purchasing to integrated sustainable supply chain management flowing from supplier to manufacturer and to the end user as well as retailers (Zhu and Sarkis, 2004). The increasing benefits of sustainable logistics and management is champion mainly by the escalating degradation of the environment such as diminishing raw materials resources, overflowing waste sites and high levels of pollution. Hence, it is not only centred on being environment friendly, it is about business value driver and not only cost focus (Wilkerson, 2005). In this study, sustainable supply chain management is expressed as the process of incorporating environmental impact view into the sector of supply chain management. This includes, among others, product design, material sourcing and selection, manufacturing processes, delivery of the end products to the end users as well as the life cycle management of the particular products at the expiration of its useful life.

On the other hand, Ready-mix concrete order fulfilment is a typical batch process whereby the customer which in this case is the contractor forward an order to batch to the supplying process, that is the batch plant and then receive the concrete product thereafter. In this traditional means, the batching procedure does not give room for any catalogue of the concrete product because its a perishable product. Apart from this, for the fact that concrete must be poured in a continuous process, every 2 to 5 minute period, the dispatcher has to appraise among many other available options to decide which individual truck to allot to a delivery and as well determine which plant to direct the truck immediately the delivery is completed. Other notable challenges is the fact that there are frequent or situation changes operative conditions and orders. This includes, among others, the unpredicted delays in traffic and probably at the customer's site, variance transit times, which relies solidly on the hours of the day, high level of cancellation and modifications as a result of climate condition, variable in the order amount and mechanical breakdown of trucks and plants at any given time.

Ready mix concrete becomes green concrete when a certain percentage of cement content of the concrete is replaced partially or wholly with supplementary cementitious materials. Through the increased alertness of the emissions of greenhouse gases (GHGs) and the noteworthy impact of the cement industry, research efforts are being progressive to reduce the influences related with concrete production and consumption. A variation of methods has been suggested, one of the most common being the replacement of cement as a binder in concrete with supplementary cementitious materials, like fly ash (FA), Metakaolin, GGBS which can have lower environmental effects.

Aside this, ready mix concrete supply in a manner that is economical and resourceful relies heavily on the distance between the batch plant and the location of the site. Hence, the supplier of the concrete have to resolve how their plants distribution, in terms of geographical distribution and what production cum delivery capacity each plants should possess so as to handle the potential demand within the serviced area (Zayed and Halpin, 2001). In term of operation,the scheduling of the truck mixer and logistics management of the raw material within the batch plant are very crucial to guarantee a timely and cost effective supply (Wang et al., 2001, Anson et al., 2002).

2.0 Literature review

GLSCM is a cross-disciplinary field that has been developing in recent years with collective interest from both academia and industry (Sarkis et al., 2011). Environmental concerns like local, regional, and global consequences of air emissions, solid waste disposal, and natural resource usage have to be scrutinized and accomplished during these growth stages (Zhu et al., 2007). Accumulative environmental awareness and assurance for businesses, governments, groups and individuals have all encouraged the development of procurement and purchasing policies that integrate environmental requirements, thus demonstrating their collective bargaining and buying power (Massoud et al., 2010; Kannan et al., 2010). GLSCM is a remarkable notion to inculcate environmental thinking in traditional Logistics and Supply Chain Management (Zhu et al., 2012). GLSCM cuts through diverse borders of supply chain management, which includes business activities incorporating sourcing, making, and delivery processes, (Min and Kim, 2012). GLSCM contemplates highlighting green issues in supply chain management, in both upstream and downstream business initiatives (Shipeng., 2011). Zhu et al. (2012) argued that GLSCM is still comparatively new for most administrations in many industries (Lin and Ho, 2008) and countries (Seuring et al., 2008)".

Supply chain management shows a dynamic role in the enhancement and implementation of an organization's competitive advantage. Literature offers numerous studies and related substantiation enlightening the benefits of environmental initiatives for companies (Mudgal et al., 2010; Sarkis et al., 2011;Shipeng, 2011). The empathy of benefits for environmental initiatives and performance of companies is significant for propagation of such initiatives in Small and Medium Enterprises (SMEs) as well as large enterprises (Perron, 2005). Jung (2011) expressed Green supply chain (GLSCM) as one of the "main efforts aiming to integrate environmental parameters (or requirements) with supply chain management systems." Most supply chain management inventions in the 20th century targeted to reduce waste for economic relatively than environmental reasons, and it was at the turn of the 21st century that the term green, with focus on protecting the environment, grew extensive use and acknowledgment (Zhang et al., 2009). Modern studies remarked that in the next couple of decades, most companies will face environmental challenges in Asia (Shipeng., 2011; Zhu et al., 2012). Most industries will need to cultivate supply chains from an environmental sustainability perspective by adjusting traditional SCM to GLSCM through instigation of green procurement strategies (Mudgal et al., 2010). During the implementation of GLSCM in traditional SCM, some obstacles can be predicted due to the anticipated transition. These obstacles are called barriers and industries must prepare themselves to eradicate them. However, it will be impossible to eradicate all barriers simultaneously.

Industries should deliberate on green issues as green/eco-products can afford them with great marketing rewards and a respectable corporate image (Mudgal et al., 2010). Also, by encouraging eco-products, industries can make their own influence to economic benefits (Kannan and Sasikumar, 2009; Zhu et al., 2012) and environmental safety for society at large (Sasikumar et al., 2010; Kannan et al., 2009 a, b).

2.1. Green Production

Christie (1995) has explained green production system to mean "the producing method that minimize the production of harmful wastes and maximize the efficiency of energy and resource use and added that the ultimate purpose of this kind of cleaner production is to reduce or remove the roots producing polluted substance in the process of production for the realization of productivity improvement and energy and resource conservation." That is, employment of eco-friendly products might be the driving force for the formation of the added value of products and cost saving to the influence that the environmental elements ought to be taken into thought from the very early stage of product designing in order to cause the efficient use of resources and a basic decrease in environmental pollution.

2.2. Green Logistics

Sbihi and Eglese (2010) advocated that the way to institute plans for green logistics that can avert the waste of resources. Liu Ping (2009) stressed the interminable interest in the increase and advance of green logistics while declaring the effect produced by each environmental factor such as noise and air pollution because of transportation, waste of unnecessary packing material and other factors initiated from the factory or warehouse. Bowersox and Closs (1996) claimed that even if a logistics system become an impending cause of environmental pollution in the course of transportation and packing, from the point of a positive view, it is one of the available resources that can moderate or resolve ecological problems. Sarkis (2003) expresses the conception of environmental logistics as the combination of environmentally friendly organization management and reverse logistics. Meaning that, the arrangements of green logistics are to create a system of resource recycling by means of the critical reduction and recycling of wastes by handling the wastes created in the entire process of logistics activity from the producing stage of products to recovery and treatment. A green logistics system should also be analytically obsessed by organization from the features of strategy for core business.

2.3. Reuse

The life-cycle of a product, from the phase of production to reuse and landfill phases, needs a driving force for environmentally friendly operations and the construction of a resource cycling scheme. The strategies for environmentally friendly logistics desires a forceful drive of the 3Rs (Reduce, Reuse, Recycle) by resource spread. Professionals engage more concrete expressions to put the reusing and re-manufacturing of products indicating, the approach of higher added value and easiest to be grasped among the notions of environmentally friendly production, over the improvement of product use and extension of lifespan in the circulation of the product.

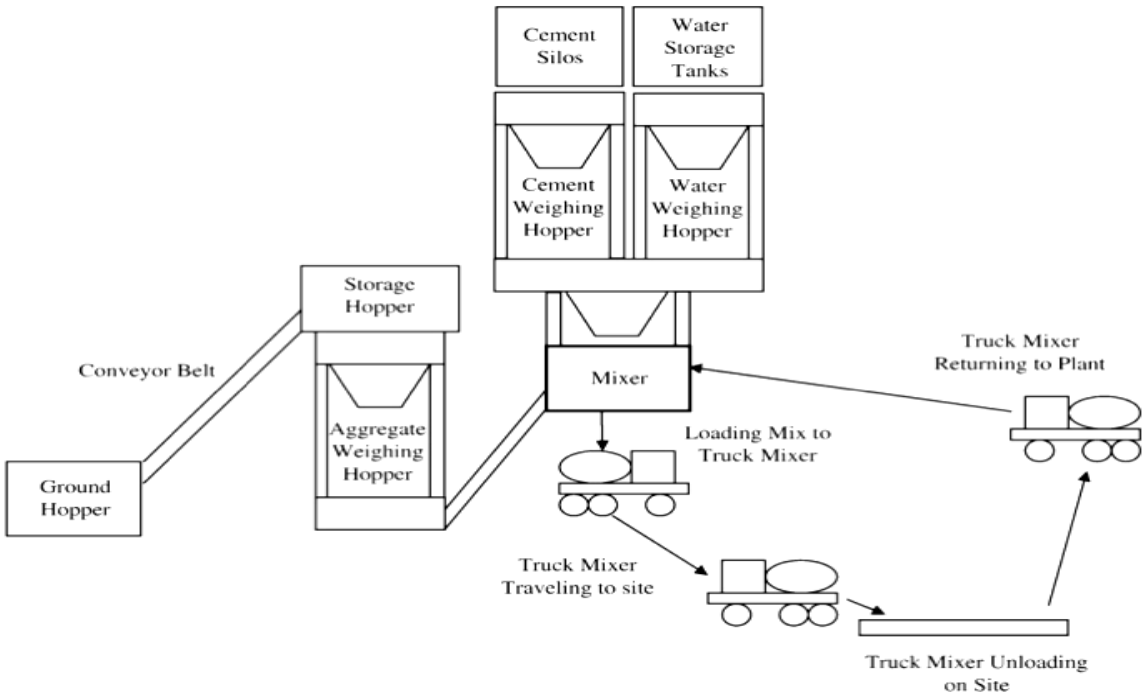
Research Methodology

The main focus of this paper is to Juxtapose the traditional method of ready made concrete supply and the utilization of green logistics and SCM. Diverse ready mix concrete operations have suggested discrete event simulation models in which all states variables are bring up to date only at a disconnected set of points and each point denoted as an event time deprived of any action between successive event times (Zayed and Halpin, 2001). While, this arrangement appears to be valuable and resourceful in undertaking some issues and lead to the near optimal dispatching interval, it does not essentially incorporate managerial responses and environmental health factors. Therefore, this paper employed a method of case study to analyse, descriptively, the factor for order fulfilment in the view of green logistics and supply chain management.

Traditionally, the customers of any ready mix plants are served not only by mixing, but as well as transporting of the ready mix concrete and conveyed it to the location for placement on site. In a more professional term, it can be called a pull system whereby a feedback techniques are involved.The product is then produced and delivered to meet the need as demanded. In the contrasts, the products can be produced in expectation of meeting an urgent request, this is founded on forecast need. In order to appreciate, the batching and delivery process otherwise known as the supply chain management, a local company in Malaysia was visited.

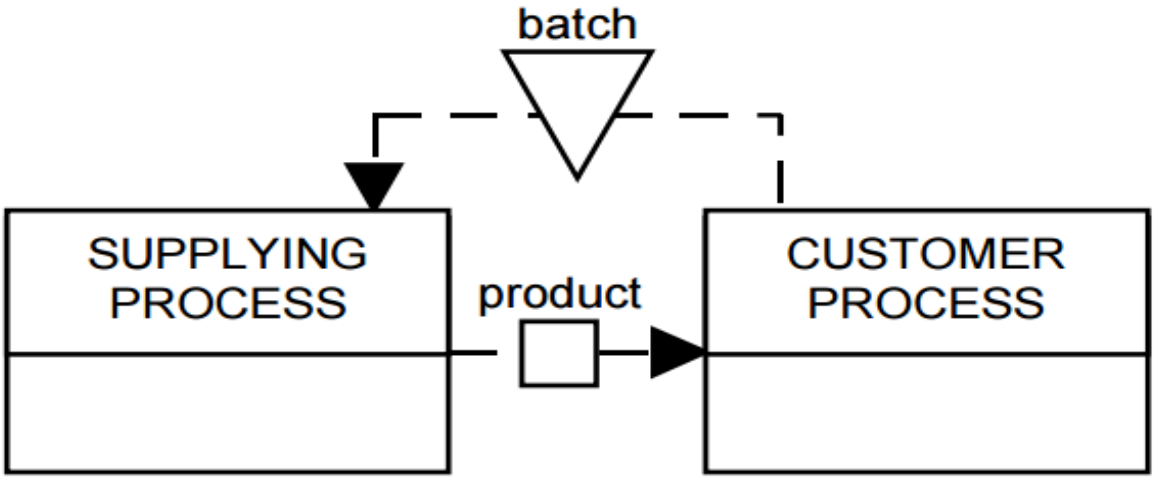
A typical example of the traditional means of ready mix concrete batching is shown in Figure 1. While a prototype illustration of a batch process is given in Figure 2.

Figure 1 Traditional batching and delivery Process of ready mix concrete (Zayed and Halpin, 2001).



In this method, the production, batching involves the deployment of labour and plant materials, handling of concrete raw materials to the batch plant and the material storage at the plant. There are ground hopper, storage hopper, cement silo and a water storage tank, weight hopper, mixer and truck mixer in the concrete batching plant visited. The performance of the batching procedures is authorized by the processes that confirm the aggregate weight and discharge the concrete materials to the mixer. This is due to the fact the loading of aggregates and sand from the ground hopper is self-regulating as the operator generally fills the storage hopper irrespective of whether the plant is in operation or not. The time value taken to confirm the weight of aggregates at the time of the material discharge into the mixer was estimated to be 5.31 minutes and 8.22 minutes respectively.

Figure 2 The traditional batching process of ready mix concrete (Tommelein and Li, 1999).



Likewise, the truck mixer performance was observed, although, the performance of the truck mixers varies and it depends the system of concrete placement methods utilised on the site. The loading time for a truck driver take an average of 1.20 minutes while the driver uses an average of 1.50 minutes for realigning and position of the truck for loading. It also takes an average time of 2.75 minutes for a batch of concrete to be tested for standard workability using slump test. The testing is necessary to ensure standardization and quality ready mix concrete. A typical average time for travelling between concrete batching plant and construction sites is shown in Table 1.

Table 1 Average time of travelling by a truck mixer from batching plant to site. (Park et al., 2011).

Type of unloading	Number of deliveries (truck)	Avg truck mixer dispatching interval	Avg time to position	Avg time to load mix	Avg time for slump test	Avg time to haul	Avg queuing time on-site	Avg time to unload	Avg time to return	Avg time taken for delivery
Crane and Skip	39	18.30	1.58	1.27	3.01	23.04	29.94	20.05	24.92	103.81
Wheel barrow	12	20.7	0.79	0.63	1.50	21.50	22.77	25.90	20.50	93.59
Tremie pour	16	6.30	1.84	1.55	2.95	22.31	12.01	9.50	24.44	74.60
Pump pour	9	8.10	2.11	1.04	2.76	21.33	16.96	13.85	21.67	79.72
Direct pour	24	7.50	1.50	1.33	3.07	22.21	12.06	9.24	24.67	74.08
All types[a]	100	13.15	1.55	1.23	2.81	22.38	20.76	15.91	23.96	88.60

While arriving at the site location, truck mixers usually queue for some time, an average of 20.76 minutes. Meanwhile the average time for the offloading of concrete from truck mixer is 15.80 minutes. This ranges from direct pouring with an average time of 8.23 minutes to the wheel barrowing pouring of an average 25.90 minutes. In a nutshell, it took almost 88.50 minutes to deliver a a batch of ready mix concrete.

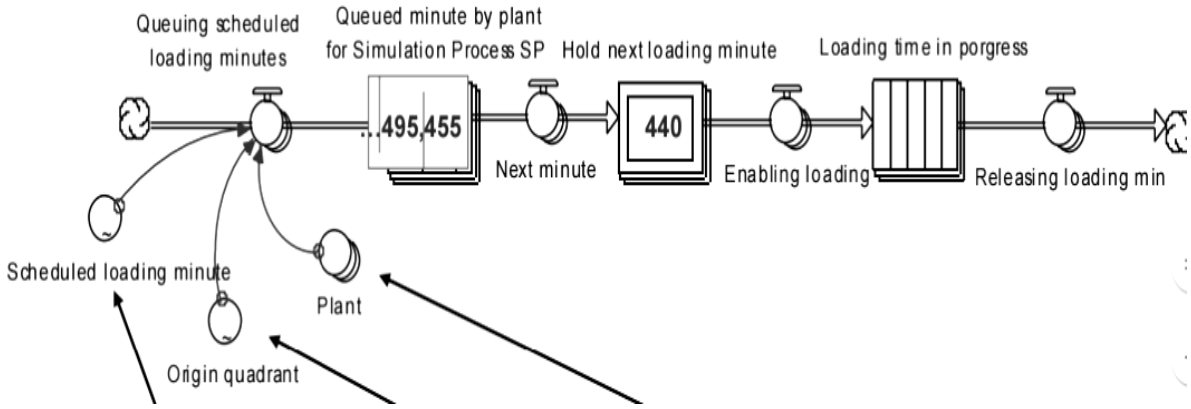
When this is compared to one of the numerous model structures of batching and delivery of ready mixed concrete, one can not but to prefer the green supply chain management factor and values. A good example of this model is the one called Simul model developed by a research group based in Mexico.

In the model, service and cost are the two basic principles that dictate the procedure in the order fulfillment processes. It involves the customers making an order and then taking the order otherwise known as order taking), then making the scheduling and dispatch, production and loading and finally, the delivery.

The Model Description

The Simul Model embraces inputs and outputs. The input segment encompasses scheduling and dispatch orders and the operative parameters while the output includes the key indicators and details per plant. This two section is simulated and the simulation will definitely assist the dispatchers to predict potential issues and any delays attached to lack of trucks or in case of over demand in the plants. Figure 3 shows the data loading section of the Model structure.

Figure 3 Data loading process of Simul model.



In the structure, the details of each loading and the schedule loading time is allotted to its plants accordingly. It precisely present the queuing scheduled loading time, the queued minute by the plant and the loading time in progress.
In a situation whereby the loading plant is free, the truck is readily available at the plant and the simulation minute is equal or greater than the minute of loading, then there is a shift of the loading minute to the loading stock, meanwhile at same time, the truck is moved to the loading location.

In the same vein, all the characteristics of every delivery, which comprises of the loading time scheduling, transit time and cubic meter capacity of the truck move through the model concurrently.

In terms of cycle time calculation, the average cycle time of the truck is estimated from the minute the truck commences loading by the time the same truck gets back to the plant.

A typical example, using simulated time of 440 minute inputs in the model
Then, the journey period from plant to site is 30 minutes
The unloading time at the site is 15 minutes
While the journey back to the plant is 30 minutes.

The total minutes for the journey of the ready mix concrete delivery is 515 minutes. Which means for this typical load, the estimated cycle time is 75 minutes.

Analysis and Discussion

Placing this green supply chain management of the ready mixed concrete delivery side by side with that of the traditional method of ready mix concrete supply, one could see that there are many factors that made it more desirable.

Time Cost factor

The suitable features of the model delivery compared to that of traditional make it more appropriate. At least there is a significant time saving in the total delivery time cycle compared to that of the tradition. This is due to the detailed features of the green model. It incorporates the principle of supply chain management that involves environmentally sound choices. This assertion was also opined by (Anson et al., 2002) in their study on measurement of the performance of ready mixed concreting resources as data for system simulation. The model was able to reduce cost of operations effectiveness and increase on time deliveries up to 90 % compared to the traditional method.

Reuse.

The green supply chain management model was designed for reuse and remanufacturing process compared to that of traditional methods. This is also justify by (Sundin and Bras, 2005) in their study on making functional sales environmentally and economically beneficial through product remanufacturing. The model cause an improve in the fleet efficiency in the maintenance service levels up to 10%.

Effectiveness of tool

The green logistics and SCM device is suitable to measure the effectiveness of the supply policies and regulations far ahead of time of usage. In the traditional method, such measures and assessment can not be ascertain. This was also supported by the outcome of the study by (Sundin and Bras, 2005).

Conclusion

The high logistics and supply performance of the ready mix concrete truck delivery depend on the operational truck mixer scheduling and logistics of raw materials, but this has principally been the hindrance factor for the suppliers of ready mix concrete. Maybe, this may be as a consequence of the differences in term of standpoints on the concrete supply performance and belief of all parties involved in the business. While the end user, that is the main contractors are more keen in the timely carriage and waste reduction so as to guarantee freedom of disruption in concrete placing on the site, the ready mix concrete supplier on the other hand, are more absorbed in reducing the operational losses in such a way as to minimize the truck mixer idle time on site. This is because, they are concentrating on the overhead cost of the truck on site wasting away time. In order to tackle this, the Simul model was developed and it was proofed to be suitable to tackle all problems associated with green logistics and supply chain management of green ready mixed concrete. The significance of this study, especially in the construction sector and concrete industry in Malaysia is as follows;

The most essential advantage of Green Logistics and Supply Chains is a positive long term net influence on the organization's financial performance. Hence, the result of this study enlightens the concrete and construction industry stakeholders on how to improve their financial performance.

Green Logistics and Supply Chains management champion the active exploitation of all the existing productive resources of an organization as exposed in this study, hence thinking through their whole business decision making practice, organizations may now procure green involvement resources that will drift through an environmentally friendly invention process to yield the anticipated green outputs.

At the central of Green Logistics and supply chain management is the standard of waste reduction by means of increasing efficiencies as shown in the result of this study. Through this, the actual management of resources and suppliers, can decrease production costs, stimulate recycling as well as the recycle of raw materials. Similarly, the creation of harmful substances like carbon dioxide can be minimized, thus forestalling organizations from being penalized as a result of disrespecting environmental regulations.

Essentially, the utilization of the simul model as studied in this research will not only fulfil the aforementioned benefits, but will also make the concrete and construction industry to be technology compliances as a waste of resources and time will be tackled as well through proper logistics.

The central limitation of this study is the focus on concrete and construction companies in Malaysia and the dearth of knowledge on the effectiveness of green logistics and supply chain management in the supply of green ready mix concrete to a construction site in Malaysia is the strong point of this study.

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