

# A Conceptual Model of Lean Quality in Supply Chain Management to Minimize Defect in Residential Houses

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## Abstract

Defect has been known as one of acute problems in residential houses projects, resulting complaints from residential users. Defects in residential houses will have an impact on the budget swell with the repair and rework to be done by the contractor. In the end, repair and rework will cause the delay of handover of the house to the customer.

The research proposes a conceptual model of Lean Quality in Supply Chain Management to tackle defect problems in residential houses. This new concept is an integration of previously known approach, i.e. Supply Chain Management (SCM), Total Quality Management (TQM), and Lean Construction. While SCM focuses on managing flows of materials, information, equipment, etc, TQM emphasis on managing factors of quality, Lean Construction minimizes waste to maximize value for customers. Lean Quality in Supply Chain Management (LQ in SCM) promotes a new perspective to create a quality product with the implementation of time-efficient construction process, cost-effective and minimal waste to the entire of supply chain in construction projects. This paper proposes of SCM, TQM and Lean Construction to minimize defects in residential houses, based on the literature study of SCM, TQM and Lean Construction concepts. This new concept is expected to be adopted by stakeholders to minimize defects in residential houses. Where the stakeholders will do their work in accordance with the standards that have been determined by paying attention to the process of existing construction work, resulting in a good quality home building products to realize customer satisfaction.

**Keywords:** SCM, TQM, *Lean Construction*, Integration, *Defect*

## 1. Introduction

Building defect is one of the major components of building problems that significantly need attention. Failures and defects can cause unnecessary expenditure and delays [16]. Meanwhile, the construction defects are a major concern of the construction industry. With various types of facilities / buildings built to produce various defects and demands varying degrees of quality depending on the function, system, and type of materials used, although varied systems have been created to reduce defects through construction work [6].

In order to create a good working process so as to produce a quality product, a system capable to manage and manage all existing supply chain activities is needed using SCM philosophy [17]. If the SCM philosophy is enforced, then the problems associated with traditional practices in the construction industry can be solved [5]. Effective SCM has become potentially valuable way of securing competitive advantage and improving organizational performance since competition is no longer between organizations, but among supply chains [15].

But in reality, the supply chain construction is still full of waste and problems. The characteristics of complex construction supply chain reinforce the existing problems of the construction supply chain, and may block SCM applications into the realm of construction, therefore proposed practical SCM solutions in the construction field, which correspond to the specific characteristics and conditions of each supply chain construction [25], that is by integrating it with other concepts such as TQM. TQM practices not only have a direct positive impact on SCM practices and enterprise chain performance, but also indirectly positively impact the performance of the enterprise chain through SCM practices [24].

On the other hand, SCM is close to the 'Lean' approach. The management goal of 'Lean' to achieve 'Zero Waste'. Source of waste comes from: over production, waiting time, transportation, process of achievement, non-essential inventory, unnecessary movement, and defect [22]. Lean concept can have positive effect on SCM based on 2 (two) reasons, first Lean Philosophy directs to reduce waste in production process, while supply chain also have the same principle related to repair system. Second, Lean management offers integration in the process, as is SCM that manages the supply chain in the process. Knowledge transfer through integration becomes important in order to increase zero defect and reduce inventory. In practice, effective SCM will only be enhanced through the Lean philosophy [20].

Based on the above, it can be concluded that SCM concept will have a positive and significant impact if combined / integrated with TQM and Lean Construction. Because TQM will be an important concept to maintain supply chain quality so as to produce a quality construction product [7], while incorporation of lean techniques into the supply chain will show high potential for a significant increase of all construction performance [4].

The aims of the research is to develop of the integration of SCM, TQM and Lean Construction to minimize defects in residential houses. The method used is a literature review of SCM, TQM and Lean Construction tools. These tools are selected which have a direct impact on the minimization of defects in construction process of residential houses.

### 1.1 SCM

SCM is an innovative and revolutionary managerial approach that includes changing work culture and agreements, to integrate and synchronize two or more members at different organizational levels and to reach the inner network within the construction project cycle (initiation in handover). It is a collaborative effort and strategy in all activities undertaken according to trust, responsibility, profit and risk sharing based on the perspective of long-term relationship. Value is enhanced through optimization and management processes, resources, core competencies, aligns, information, power and technology in the supply chain through a number of goals and objectives, able to deal with competition, break down discontinuities and understand client needs. Consequently, approved benchmarks, targets, expectations and values are placed on continuous improvement efforts and driven incentive schemes through sustainable enterprises. [3]. Since the main purpose of SCM in the context of construction is to offer better value to clients in competition (Construction Excellence, 2004), that is by doing a combination of:

1. Define client value.
2. Establish a relationship with suppliers.
3. Integrate activities.
4. Setting the combined costs.
5. Developing sustainable improvements.
6. Moving and developing people.

A method for analyzing and describing SCM within the scope of construction is to use horizontal structures and vertical structures to manage problems in the supply chain. Horizontally, different members of the supplier are grouped into upstream and downstream groups as primary consultants, prime contractors, sub contractors, sub consultants, and suppliers of services / materials. Vertically, there is competition among suppliers within the same members. At this level, highlighted issues relate to market competition and differences between suppliers, where problems are analyzed using measurement techniques to select, certify, assess and provide feedback to suppliers [14].

### 1.2 TQM

TQM and building construction is the result of commitment by all personnel, this commitment must be established from all related parties for the process of construction implementation in the field. It is a process that requires proactive teamwork, the need for training and self-assessment of the abilities and resources available to achieve the desired goals [9]. TQM's goal is to achieve customer satisfaction, cost effectiveness, and defect free through endless efforts on "war on waste". The customer will be satisfied if the product has a low defect (even none or zero) and the price is competitive with the offer from other suppliers. TQM achieves customer satisfaction through a focus on process improvement, customer and supplier engagement, teamwork, training, and education. TQM is a culture that advocates on total commitment to customer satisfaction, through continuous improvement and innovation in all aspects of business. The customer, in an ideal culture, does not mean only the ultimate recipient of the organization's final product or service.

"Customer" also means any individual or stakeholder in any organization. [11].

In order to benefit TQM implementation, it requires the involvement of all stakeholders who must be trained on the concern for TQM, interest, desire, and action. Plus the attention of the top leadership focused on the development of training programs in adopting and implementing TQM. Companies should care about suppliers as business partners and realize TQM implementation so as to benefit, such as understanding consumer needs, improving internal communications, better problem solving and improving the competitiveness of the company [2].

### 1.3 Lean Construction

Lean Construction has fundamental principles found in the production and industry sectors through the Toyota Production System (Koskela, 1992; Howell, 1999). The Lean Construction's theoretical idea is the transformation, value and flow elements supported by tools for waste removal and productivity enhancing strategies, illustrated in Lean Last Planning (see Ballard, Howell, Mocember, etc.). Strategic tools designed according to lean implementation interpretations (such as LLP) will help lean understanding as an important strategy in reducing waste (Koskela, 1992; Egan, 1998; Howell 1999) and increased productivity (Koskela, 1992; Howell, 1999; Pavez, Et al., 2005) without considering the cultural impact ('industrial' issue) [8].

Traditional construction management emphasizes only on conversion activities and does not pay attention to the problem of managing systems and design processes into flow activities. While Lean Construction has at least 2 (two) focus areas, namely reducing waste (waste reduction) and management flow (the management of flow). Production system consists of 2 (two) aspects, including 1. Conversion (conversion) of materials, information, and other inputs then transformed into a product, and the second 2. Flow (flow), where activities that do not bring value (non value adding) and contains activities such as inspection, waiting, or movement, should be reduced or even eliminated [10].

### 1.4 Defect

The concept related to the rules of the construction industry in recent years is a matter of economic development. Many studies link the construction sector and economic growth in a country, and have a significant effect between the two. The construction industry faces challenges of low productivity, low safety, less friendly working environments, and low quality, and one of the main concerns is waste, which should be the main concern of construction actors. Alar (1995), Koskela (1993), Robinson (1991), Lee, et al (1999), Pheng and Hui (1999), and Alwi, et al. (2002) who stated that the major waste categories in the field Construction is reworks / repairs, defects, material waste, delays, waiting, poor material allocation, unnecessary material handling, unnecessary movement or displacement, inaccuracy in the selection of work methods, and equipment management [12].

## 2. Proposed Models and Proposition

From the above explanation, it can be seen that research on SCM and TQM integration, SCM and Lean Construction integration that have positive effect on organizational performance has been done by some previous researchers. The concept of LQ in SCM as the integration of SCM, TQM and Lean Construction shown in Figure 1 below:

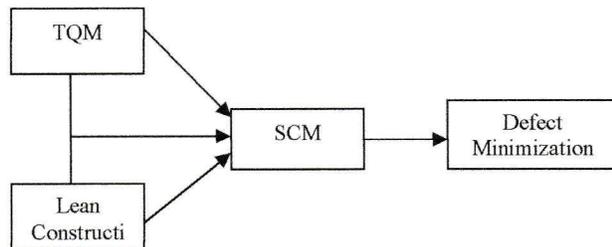


Figure 1. Model of SCM, TQM and Lean Construction Integration Concepts

From Figure 1 it can be explained that the concept of TQM and Lean Construction must be integrated into SCM. Both concepts must be implemented simultaneously and should not be done individually so that the final goal to minimize defect can be achieved. In addition, it is expected to achieve customer satisfaction, both within the organization such as developer, contractor, and sub contractor, as well as external organizations, such as suppliers of building materials and end consumers, and at the same time can improve the existing supply chain productivity.

### 2.1 Integration of SCM with TQM

TQM has improved for adoption in construction companies as a way to solve quality problems and meet consumer desires. Therefore, TQM must be integrated into the quality management activities undertaken by all members of the supply chain. Through an in-depth case study of construction companies in Hong Kong, TQM concepts, strategies and structures are used to manage existing supply chain members, such as suppliers and subcontractors. The results of the study recommend that for further research it is necessary to develop and improve the integration between TQM and SCM [26].

There are many similarities and differences between TQM and SCM. Understanding and comparing TQM and SCM can identify management development frameworks by integrating between the two. TQM and SCM can be viewed as an unlimited management philosophy and potential to be applied. In practical terms, implementation will be difficult because the definition of integration is unclear, so an integration framework should be made for implementation, especially the SCM framework that has not yet been universally accepted. It is further said that although TQM and SCM come from different concepts, they are united in the same way, formed in relation to the operation function, which is the main activity of the supply chain of the organization and then extends to complement each other's strategy. If TQM and SCM are integrated, then business processes and organizational structures become more complex, so that further research is directed to business processes and organizational structures simultaneously. In addition, other management issues need to be explored including the following studies:

1. The role of management in TQM in SCM

2. Information systems and technology to support TQM in SCM
3. Organizational structure and its impact in TQM in SCM
4. How education and training can support TQM in SCM
5. Cultural and behavior issues that may affect the application of TQM in SCM [24].

In this era of globalization, organizations are challenged to produce quality products at low cost at the right time and the number of suitable products and simultaneously increased flexibility. Consumers expect quality products / services, including reliability and fast delivery at a low cost. Supply chain has become the company's requirement to face this challenge. This research states that by combining TQM and SCM into SCQM will generate high profits compared to applying the concept individually. SCQM seeks to integrate quality improvement strategies and processes through the entire supply chain to bring benefits to practitioners [21].

### 2.2 Integration of SCM with Lean Construction

As a management strategy, lean production systems are suitable for SCM, which focuses on optimizing efficiency in work progress. Lean production is an in-house application that allows managers and employees to manage waste and cost reduction [19]. In relation to the development of SCM implementation in the construction industry related to the concept of Lean Construction, there are important things that must always be done, namely improvement activities, so that implementation activities become more effective and efficient and produce more quality construction products. The development of sets for SCM construction improvements will assist in their implementation to construction companies and their contractors, resulting in better performance in the supply chain [20].

The concept of lean can be integrated into the supply chain, resulting in the term Lean Supply Chain which defines a set of organizations directly linked to upstream and downstream products, services, financial and information streams that collaboratively work to reduce Cost and waste that efficiently and effectively attract what consumers need. The strategic decision to implement a lean production system is a managerial approach, but it affects top management to bottom management at every stage of the job, since lean principles allow employees to have authority [1].

Some of the research evidence indicates a high potential for significantly improving all construction performance through incorporation of lean techniques into the supply chain. The current material supply processes used by contractors in Ghana result in waste and inefficiency. The case study undertaken was to investigate awareness and implementation of Lean Construction techniques and principles in the supply chain in Ghana by interviewing 20 (twenty) professionals from the construction company selected. The result is that Ghana contractors have a low level of awareness and implementation of techniques and Lean Construction principles and long-term relationships are not a priority. Contractors face challenges related to the delivery of materials such as quality, quantity and poor order of delivery and communication problems between contractors and their suppliers. In addition, education activities will enhance the uptake of Lean Construction techniques and integrate them into supply chain management (SCM) so that they can play an important role in improving performance [4].

## 2.3 Integration of SCM with TQM and Lean Construction

Based on the opinion of previous researchers who stated that SCM can be implemented well and in accordance with the expected (such as good product quality, low cost and time, and minimal defect / waste) if the support by the concept of TQM or Lean Construction by itself. For example, if SCM is integrated with TQM (some researchers call it SCQM), then the final product is expected to be more focused on good quality with good supply chain management, but may still generate waste that will ultimately impact both cost and management techniques. Likewise with SCM integrated with Lean Construction (some researchers call it Lean Supply Chain or Lean in The Supply Chain), then the implementation is more focused on the supply chain management with the implementation of production processes are minimal waste. Therefore, it is proposed a new concept where SCM is integrated with TQM and Lean Construction, to create an end product with good product and service quality, effective supply chain management, efficient and quality, and minimization of defect / waste in production process And directly or indirectly will affect supply chain productivity in housing. The conceptual framework of this study can be seen in Figure 2 below:

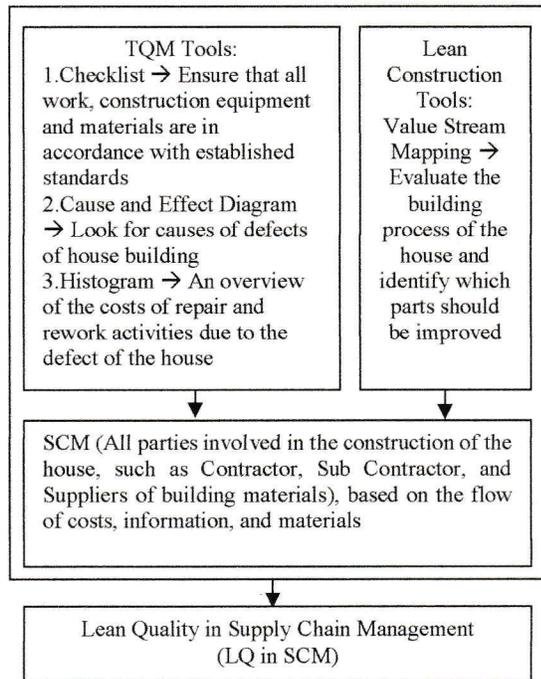


Figure 2. Integration of SCM, TQM, dan Lean Construction

Based on figure 2 above, it can be explained that the framework of the integration concept of SCM, TQM and Lean Construction into Lean Quality in SCM starts from learning about the concepts of SCM, TQM and Lean Construction, then proceeded by extracting each concept to determine the tools of TQM and Lean Construction which can be used to be integrated into SCM. The results were obtained that the entire supply chain (SCM) involved in a construction project (Contractors, Sub Contractors, Suppliers of Building Materials) must use TQM tools such as Checklist, Cause and

Effect Diagram, and Histogram to solve the defect problem on the house building. At the same time, they must also use Lean Construction tools such as Value Stream Mapping to identify the process so that it can be known which parts to improve.

## 3. Conclusions

This research has proposed a new concept of LQ in SCM. This new concept is expected to be adopted by stakeholders to minimize defects in residential housing. Where the stakeholders will do their work in accordance with the standards that have been determined by paying attention to the process of existing construction work, resulting in a good quality home building products to realize customer satisfaction.

In relation to the minimization of defects in residential buildings, the concept of SCM, TQM and Lean Construction integration would be an excellent concept to be applied by the entire supply chain involved. Because it combines three concepts in one activity performed concurrently. So hopefully will happen minimize defect in by contractors, sub contractors and building material suppliers in the housing construction process. Starting from the design process, the implementation of the construction of the house, to the handover of the house to the consumer.

The results of this study are expected to be used for the development of science especially in the field of construction management, especially related to the integration of SCM, TQM and Lean Construction concepts that can simultaneously be implemented on housing projects, so that it can become a reference for developers, contractors, sub contractors and suppliers of quality construction materials. If the quality of the building is good, it will increase the number of homes sold, and that means the doubled profits will be gained by the developer as a businessman in the construction industry. And for the community, the results of this study can be important information for them in choosing the house they will buy, which is a good quality house based on the quality performance provided by the developer.

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