The Development of a Framework for the Critical Areas When Implementing Lean in the Automotive Supply Chain in South Africa.

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Abstract

The ever-increasing global market competition in the automotive industry is compelling manufacturer in the Automotive Supply Chain to adopt and implement Lean Manufacturing (LM). The LM philosophy entails the production of products at a lower cost by minimising and eliminating the eight wastes. The value added on input raw materials should meet the customer needs in terms of quality and at a minimum possible cost. The LM implementation process has ten areas based on the 4Ps (Philosophy, Process, People, and problem solving) where obstacles to implementation exist. The paper seeks to develop a conceptual framework for the barrier areas and ways of overcoming the barriers in implementing LM especially in the automotive Supply chain industry in South Africa (SA).

Key words

Culture, management, conflict, budget, experience, and resources.

1. Introduction

The ever-rising global competition and use of scarce resources is compelling the Automotive supply Chain to reduce production cost whilst improving the value of the car by minimizing waste through adopting Lean Manufacturing (LM). The benefits of Lean are derived by reducing the risk of non-value adding activities in the manufacturing business. The companies that succeed in eliminating the 8 wastes have better quality products which retain old customers, attract new consumers, and boost the business in the Automotive Supply Chain Industry where competition is stiff. The academic work by (Lodgaard, 2016) (Antosz, 2017) and (Mbogo, 2019) show that the challenge is principally how, when and where to eliminate the 8 wastes.

Eight companies in the automotive Supply Chain in South Africa (SA) have been considered in the study and these companies are in the KwaZulu Natal province (KZN). A framework of the barrier areas encountered when implementing LM is constructed and an IDEF model is developed to summarise the findings.

2. The Literature Review

The focus is on the manufacturing areas where the generic barriers exist as discussed in the academic work by (Kumar, 2014), (Singh, 2014) and others. The initial study revealed five major issues that are critical when implementing LM for the first time. The issues are centred on the customer ,

organization, supplier, market, and top management influence on implementing LM. The strategy should therefore consider these issues and barrier areas before implementing LM.

2.1.1 The critical areas in lean implementation

The academics (Kumar, 2014), (Tan, 2020) and (Koohestani, 2020) identified the basic ten broad areas that have hindrances in implementing Lean for the first time. The ten areas will have an impact on the strategy used in implementing Lean in the Automotive Supply Chain in South Africa. The areas need to be investigated to establish the factors and challenges that affect the level of success by each industry in the supply Chain. The study will consider two scenarios, one where more than one Lean technique is implemented in an integrated manner and the other where a technique is implemented alone. The factors and challenges faced by different suppliers are used to develop a model that offsets challenges in future.

2.1.2 The Knowledge area

The goal of LM knowledge Area is to understand, apply, measure, and evaluate the performance of each technique to save costs, and reduce wastes. This increases flexibility and drives employees to have a common objective of lean implementation (Chiromo, 2015) (Netland, 2016) (Thakur, 2016) (Nordin Norani, 2018).

The principal knowledge areas to offset the eight wastes are the 5S, Jidoka, Poka Yoke, Kanban, Just in Time (JIT), Heijunka (production smoothing) and the Gemba walk. It is a must to acquire the underpinning knowledge in Kaizen, 5S, VSM, quality circle, reduce setup time, multifunction skill and preventive maintenance before launching advanced LM practices such as small lot sizes and one-piece flow (Kumar, 2014) and (Yahya, 2019).

The strategies and methods used to impart knowledge of the factors and challenges that impedes the implementation of LM in the Automotive supply Chain in SA. Senior management require the knowledge to create the environment that enable workers to add value. The workers need to understand the importance of small improvements over long period of time instead of treating it as a once off initiative. It is critical to provide a full education and training package for LM techniques in collaboration with experts.

2.1.3 The Management area

A proactive management formulate strategies and methods of implementing, tracking, and evaluating LM. Outstanding performance is rewarded for its success. The academic work by (Ing, 2018), (Kumar, 2014) , (Tan, 2013), (Houti, 2019) and (Tan, 2020) deduced that the vision and improvement strategy must prepare, plan the activities and ensure that employees have adequate resources and knowledge.

The SA Automotive industry Supply Chain management requires a strategy to keep the project plan in track whilst providing sufficient support, commitment, and resources to each workstation. Rewards and moral support to the employees for small improvements motivate the workers. Senior management in consultation with all employees maximise knowledge intake and avoid conflict by demonstrating full commitment to provide resources to educate and train the workforce

2.1.4 The Human Resources Area

The philosophy needs a change in organization culture to support and empower the workers. To achieve this worker, go through training that enhances professional communication and accountability for any changes done. The academeic work by (Iuga, 2015) highlighted that the adoption and implementation of LM requires knowledge and understanding LM first.

Training and education builds and develop Kaizen knowledge and thinking for reliable, trusted team skills for changing the organization culture to LM (Iuga, 2015), (Pedro José Martínez-Juradoa, 2014) and (Memon, 2018).

The Automotive industry Supply Chain in South Africa has mixed nationalities and cultures that need careful consideration before and during implementation of Lean. The personnel factors such as benefits of practice need to be used to prevent conflicts and resistance to change. Employees need to be at the same level of understanding. Regular training, feedback and rewards motivate employees.

2.1.5 The Conflict area

In change management the failure to communicate company vision, strategy, and direction to employees and stake holders by management can increase doubts, tensions, and job security

concerns. This end up frustrating and confusing the workers if not educated and trained in the new Philosophy of LM.

The authors (Durakovic, 2021), (Jadhav, 2014), (Tan, 2020), (Qureshi, 2022) and (Maware, 2022) analysis concluded that the conflict area is a result of ineffective communication strategy, inventory management, poor quality improvements, lack of employee participation and lack of commitment by top management. The change management process needs to be clear, compelling, and credible to avoid conflicts. Employee involvement during the development of a scope of LM implementation strategic plan and benchmarking successful stake holders. An awareness that performance evaluations for possible adjustment are clearly communicated to the work force.

In the Automotive Supply chain industry in South Africa there is need to identify the conflict areas and their impact to the process of implementing Lean. Preliminary studies showed that

Cultural diversity, the blame game, lack of empowerment, poor vision and strategy, communication and lack of training are key areas of conflict when implementing LM. A change management strategy that is neutral and highly innovative is required.

2.1.6 The Resources area

The academic work by the authors (Bayhan, 2019), (Westner, 2015), (Tan, 2020) and (Alagoas, 2019) showed that resource area for LM implementation includes the availability of manpower, capital, materials, machines, and methods. The resources are provided by a committed management for employees to see the benefits of LM in their daily activities. Quality and appropriateness of the resources is important to meet the demand. Consultations and collaborations were also recommended to obtain the right resources.

The study will consider the extent to which resources are made available to implement LM smoothly in the automotive Supply Chain in SA. Availability of substandard or outdated resources and non-availability of resources will be a set back to the implementation of LM. The resources will be identified and treated on merits to avoid the 8 wastes.

2.1.7 The Finance area

The finance department should have a positive budget for all resources inputs required for LM implementation. An adequate budget is set for each resource and process in LM programs by a highly trained and experience teams that involve workers.

A favourable training and resource-allocation budget is required to set up smart factories as hinted by (Westner, 2015), (Alefari, 2017), (Radziwon, 2014) and (Dora, 2016) in their academic work.

The Financial resource is an enabler and change agent that allows training of employees at the site and outside. (Kumar, 2014) highlighted that LM does not have direct financial payback but supports the process of identification and elimination of waste to reduce cost.

The SA automotive Supply Chain in study has most of the training done at TSAM with modern facilities and equipment. When the trained workforce from suppliers go back to their centres, they will recommend the purchase and establishment of similar facilities and equipment. The Supply Chain need to have funding for the LM resources to be used on site, other site visits and training at benchmarked organizations will speed the process. Inadequate capital to provide resources is a barrier to lean implementation. The implementation of LM requires adequate capital to roll out and sustain it since the Return On Investment (ROI) or payback is not immediate but long term of ∓ five years.

2.1.8 The Experience area

Experience is critical in the attempt to adopt the LM philosophy the second or third time. It becomes a big obstacle when a couple of LM projects attempted in the past where not successful because of different perceptions (Rakesh, 2014) and (Kumar, 2014) . This divides employees, some will resist because of poor knowledge and understanding, and others will buy-in the philosophy. The reasons of failure can be poor initiation, lack of strategy and backsliding to old methods which workers have confidence in.

(Koohestani, 2020) recommended a risk assessment evaluation to be done based on the previous attempts which were unsuccessful. If the previous attempts where a success a risk management exercise will also be done to improve this time around according to Kaizen philosophy.

In the automotive industry some companies succeeded in implementing LM first time and others had hiccups. It is essential to determine the root causes analysis (RCA) strategy of failure and apply the SWOT analysis strategy to improve the implementation process.

2.1.9 The Organization culture area

The organization culture area embraces the organization policies on promotion, discipline, ethics and values, ethnicity of employees, gender, the cultural values, autonomy, and equity to mention but a few.

The academic work by (Panwar, 2016) (Hibadullah, 2014), (Kumar, 2014) and (Tan, 2020) show that the LM culture exploit the mistakes in Manufacturing as the source of continuous improvement rather than a blame to the worker. The "no-blame culture," in LM allows a change of poor attitudes and behaviours and strive to make small improvements daily. The change from mass or batch production to LM culture builds autonomy among employees when they get involved in decision making. This empowerment gives employees a sense of responsibility, accountability, and ownership of the organization instead of taking instructions.

The SA automotive Supply Chain is multi-national and has a diversity of culture among employees. These work alongside with co-workers, superiors, contractors, and suppliers from different countries with different beliefs, attitudes, behaviours, and languages that may impede coordination and cooperation, resulting in conflicts. LM embrace the empowered culture that is centred on a customer centric leadership that is innovative and competitive in the market.

2.19. The Technology area

For an organization to implement LM it requires the appropriate technologies from the starting phase. Lean software's and equipment must be purchased, installed, and commissioned in the plant. The workers must be involved in the selection and training on how to use the technology. The software should be linked to all stake holders in the supply chain to ensure the orders are done at the right time (Kumar, 2014).

(Koohestani, 2020) suggest a confusion between technology adoption with automation should be checked so as not to neglect planning. For the production line flow of materials and resources, the Kanban software is essential to control the Takt times for components. The visual Andon light methods is a critical and instant communication tool in the manufacturing floor. The use of Six Sigma in the Lean 100% quality testing at each station is an important technology that ensures no defect is passed from one workstation to the other.

The study will consider the impact, strategy, and success factors of the technology area in the Automotive supply in SA for supporting the implementation of LM. It is critical to involve the workforce through the worker Unions to invest in technology which is not too sophisticated but user friendly. If the technology is too sophisticated, it will meet resistance because of fear of victimisation.

2.10. The customers satisfaction area

Small and new enterprises have lower global market share till they embrace modern and innovative LM approaches to attract more customers. This area has two types of customers, those that purchase the product and resale and those that use the product. (Koohestani, 2020) recognized the power of lobbying as the key to win new contracts from a distributer and the end user spare parts sales outlets. Both need to be satisfied by quality of product and efficiency of supply to remain in business.

The bedrock principles of LM are designed to develop a comprehensive e-commerce business model and maximize the chances of success. In the academic work by (Simatupang, 2016), customer service was treated as a principal strategic device to win new contracts and retain the old. The marketing, purchasing, shipping, and supply service departments must support LM to fulfil and satisfy the customer requirements (quality and lead times).

In the Automotive Supply Chain in question, the impact of customer focus, cross function teams, technological infrastructure and communication in the implementation process are essential to visualize the improvements required. The key elements in customer satisfaction are to meet demand, provide quality, fulfil orders at minimal cost and to deliver at the promised time. This helps to retain old customers and attract new clients demanding the application of Heijunka levelling.

2.1.10 The marketing area

Today there is need for a strategy for green supply chain marketing and green purchasing to add value to the right materials without polluting the environment. The transport industry is experiencing fuel consumption, maintenance, repairing expenditure and transportation cost which can be reduced indirectly by applying Green supply Chain principles in disposal, recycling, and reuse (Saridogan, 2012). Old tires are used to make stadium lawn, carpets, and tiles for gyms by VanDyck and Redisa whilst used oils are recycled by FFS in SA.

Green purchasing and consumers buy and use green raw materials for the production process and produce products that are environmentally friendly. All waste materials and biproducts are processed and consumed by a downstream industry in the Green Supply Chain (Sugandini, 2020).

2.1.11 The core values area

The academic work by (Raut, 2015) and (Coetzee, 2019) showed that core values are used to resolve challenges of LM such as set up times through the Single Minute Exchange of Dies (SMED) tool. Simple designs and use clamps instead of fasteners reduce the set-up times for the dies. Reverse engineering using Poka Yoke improves the quality and repeatability of product and reliability of the process. The establishment of collaborations and change management teams helps in levelling the demand (Heijunka). This area helps to reduce rejects, rework, process and set times. A reduction in rejects, rework and fault deliveries will improve the market share.

The overall needs of employees at the workplace, social and religious improve with respect for people (RFP). RFP motivates innovation among employees thus utilizing one 's talent. It also brings job satisfaction and improves teamwork and cross function teams. If properly handled, Core values increase knowledge and develop the culture for excellence and integrity in solving problems.

2.1.12 The profitability area

Profitability rations indicate business performance and liquidity of the company. The strength and weakness of the company is measured by the profitability ratios. Dissatisfaction, decline in customer and worker confidence, negative word of mouth and decrease in employee morale and performance is brought by low profitability. Implementing LM may be ideal in such an environment because the workforce and management will be eager to improve the productivity and remain employed (Shahin, 2010). In the automotive Supply chain, a motivating treatment of workers by management, interventions, customer's perceptions, building customer relations and loyalty will ease the implementing process.

2.1.13 The motivation area

The academics (Sathe et al., 2017) the motivation area to be critical in implementing LM. The authors sighted extrinsic motivation (holiday with pay, medical, fees, transport subsidies) and intrinsic motivation (recognition, promotion,) which is awarded through performance incentives like bonus stimulate voluntary performance. Absence of motivation is one challenge that makes implementation to fail. If the workforce in the automotive Supply Chain is not motivated implementing challenges may escalate.

3.   Methodology

The research used a one-on-one interviews and case studies with training personnel, student mentors and team leaders. The responses were according to their personal experiences and views in the automotive supply Chain industries in SA. Since the industry has many players in the global market competition ethical needs and intellectual property rights limited the study to the supply chain industries.

4.   Results and discussions

The results obtained were used to develop a framework of the barrier areas and modelling the proposed strategy in the implementation of LM using the IDEF software. IDEF is a Functional Modelling method designed to model the decisions, actions, and activities of an organization or system.

4.1   The Framework of proposed barrier areas

Fig 2 shows the framework that has been developed from the various literature study and preliminary interviews with the Automotive supply chain training managers. To validate the framework a

questionnaire will be compiled and distributed to the automotive supply chain industry and experts to get the responses for validation and modifications.

The framework will be followed by the development of implementing method criteria for each LM technique starting with the low levels 5S, JIT, SMED and Kanban in phase 1 then the high levels Poka Yoke, Heijunka levelling, Jidoka and single product flow. For each a performance evaluation and feedback will be executed and displayed to motivate and celebrate the wins noting that the blame approach has no space in LM. Some industries lag in development because of less knowledge and understanding of the barrier areas, lack of resources, skills and desire to develop a framework for implementing LM.
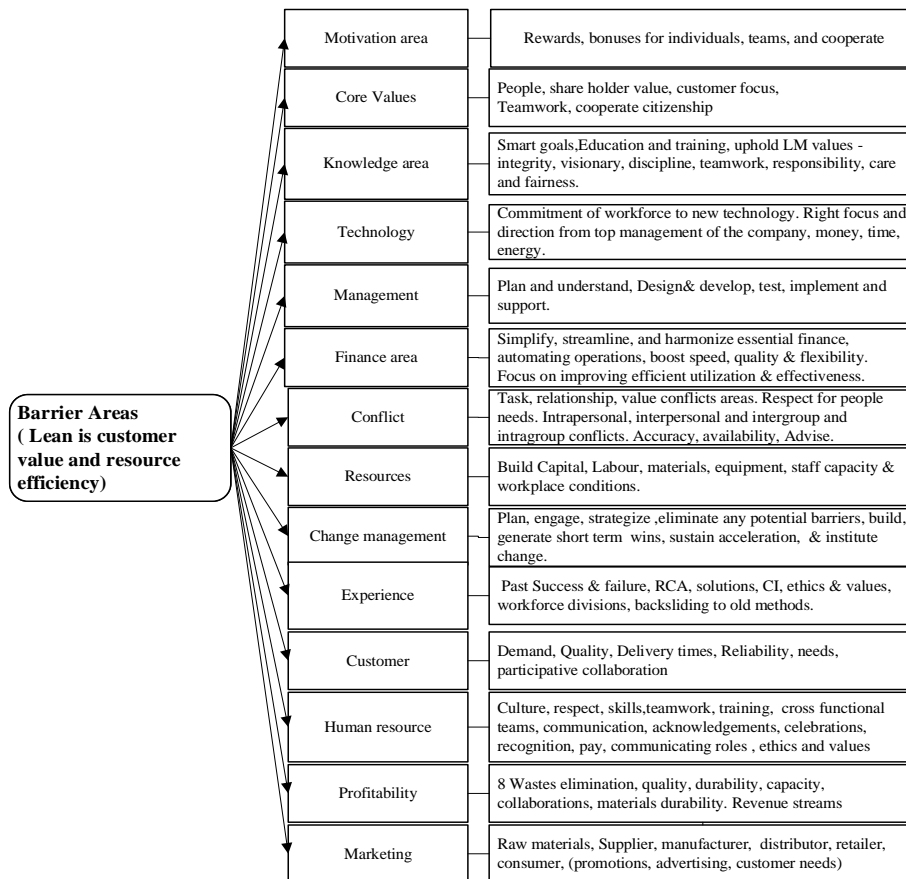
Barrier Area	Description
Motivation area	Rewards, bonuses for individuals, teams, and cooperate
Core Values	People, share holder value, customer focus, Teamwork, cooperate citizenship
Knowledge area	Smart goals, Education and training, uphold LM values - integrity, visionary, discipline, teamwork, responsibility, care and fairness.
Technology	Commitment of workforce to new technology. Right focus and direction from top management of the company, money, time, energy.
Management	Plan and understand, Design& develop, test, implement and support.
Finance area	Simplify, streamline, and harmonize essential finance, automating operations, boost speed, quality & flexibility. Focus on improving efficient utilization & effectiveness.
Conflict	Task, relationship, value conflicts areas. Respect for people needs. Intrapersonal, interpersonal and intergroup and intragroup conflicts. Accuracy, availability, Advise.
Resources	Build Capital, Labour, materials, equipment, staff capacity & workplace conditions.
Change management	Plan, engage, strategize, eliminate any potential barriers, build, generate short term wins, sustain acceleration, & institute change.
Experience	Past Success & failure, RCA, solutions, CI, ethics & values, workforce divisions, backsliding to old methods.
Customer	Demand, Quality, Delivery times, Reliability, needs, participative collaboration
Human resource	Culture, respect, skills, teamwork, training, cross functional teams, communication, acknowledgements, celebrations, recognition, pay, communicating roles, ethics and values
Profitability	8 Wastes elimination, quality, durability, capacity, collaborations, materials durability. Revenue streams
Marketing	Raw materials, Supplier, manufacturer, distributor, retailer, consumer, (promotions, advertising, customer needs)

Barrier Areas (Lean is customer value and resource efficiency)

Fig 2 The framework of the fourteen Barrier areas in implementing Lean manufacturing in the automotive industry in SA, J. Zvidzayi

4.2 Modelling of the implementation strategy (IDEF)

The study revealed the need to develop an implementation requirements model that will be used to design the methods of applying each LM technique and the construction of the system. Fig 3 shows the simple model where input needs are compiled, validated and fed into the design methods design system. The designed methods feed into the actual implementation system where it is processed with other inputs such as resources to produce a lean practitioner.
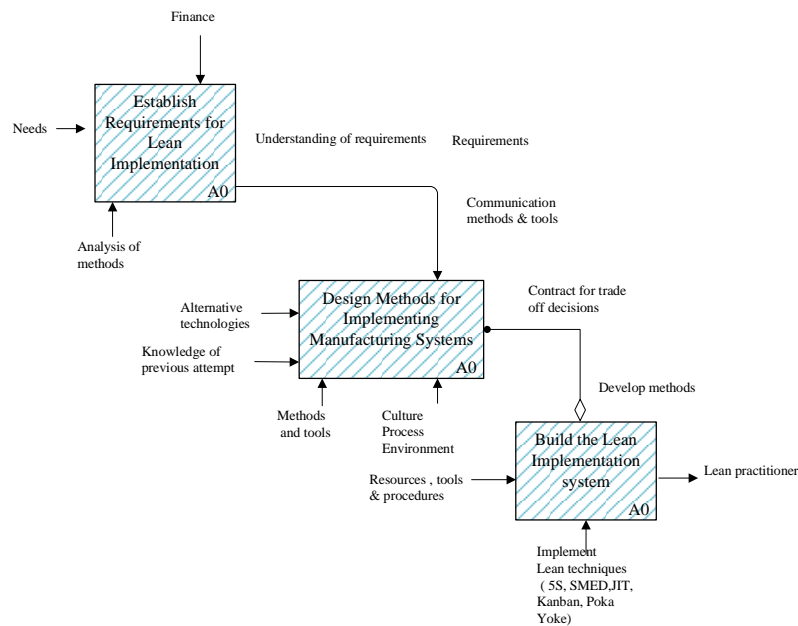
Finance

Establish Requirements for Lean Implementation
A0

Needs →

Understanding of requirements

Requirements

Analysis of methods

Communication methods & tools

Design Methods for Implementing Manufacturing Systems
A0

Alternative technologies →

Knowledge of previous attempt →

Contract for trade off decisions

Methods and tools

Culture Process Environment

Develop methods

Build the Lean Implementation system
A0

Resources , tools & procedures →

Lean practitioner

Implement Lean techniques (5S, SMED,JIT, Kanban, Poka Yoke)

Fig 3 Modelling Lean implementation strategy in the Automotive Industry Supply Chain in SA. By Authour

5.   Conclusions

The framework enhances the body of knowledge to fill the gap for the successful implementation of lean. The study provides insights, risk management and guidelines for implementing lean. It provides requirements and knowledge of the 4Ps of Kaizen the philosophy, process, people and partners, and problem solving for continuous improvement for new adopters of LM. The automotive Supply Chain intend to uphold the LM values integrity, visionary, responsibility, care, fairness, discipline, and teamwork to meet the global market needs and competition.

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