



LEAN Management (LPDS) and its Application in achieving Sustainable Development in Bangladesh.

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Executive Summary

LPDS has been there for generations after generation but TMC has rejuvenated the idea adapting more smarter management practices aimed at minimizing or eliminating waste by empowering customers. Hence Lean is about Management, Workers and the Trust that binds them together. TMC has fine tuned the technique and made it more socially responsible and kind to the environment. Currently Lean is leading green revolution and efforts are being made to become green throughout their supply chain.

Lean implementation has changed corporate culture, tradition and ways of conducting work forever. It is a process of continual improvement by plugging the loopholes through the identification of sources of inefficiencies and wastages. A dynamic leadership equipped with lean knowledge, and experience can provide the necessary momentum and the incentive to bring ecologically sustainable development adhering with the process of Lean transformation.

The years 1979-1985 have been identified as the "Resistant Adaptation". The second stage, the mid 1980s has been identified as companies "embracing environmental issues without innovation". The third stage of the late 1980s consisted of "Reactive" organizations using "end-of-pipe" solutions for treating waste, but little efforts to prevent waste production. In the "receptive" stage, the early 1990s the organizations began to see environmental considerations as a source of competitive advantage. Mid 1990s witnessed the "constructive" stage when organization began to adopt a resource-productivity framework to maximize benefits attained from environmental initiatives (Fliedner, 2013).

The UN introduction of Triple Bottom Line Principles (Economic, social and environmental value) has greatly raised public awareness. Nations around the world were obligated to formulate stringent regulatory requirement for manufacturing and other service industries to bring ecologically sustainable development.

The UN Charter coupled with stringent regulatory requirements along with increasing resource price and elevated cost of proper disposal has forced giant companies to bring corporate social responsibility in their company manifesto.

The development of world class sustainable program typically proceeds in a step wise fashion (Fliedner, 2013). First, process-based capabilities are instilled internally in a single set (vertically). Second, step dominated integration and coordination of several activities (horizontal). In the last step, services based industries developed network-based production chain and included value chain partners to achieve sustainable development.

The underlying philosophy of Lean Management principles are waste minimization or no waste at all. Sustainability is an extension of Lean Principles. With that slogan in their corporate agenda Lean is constantly thriving and searching and introducing ways and means to make their manufacturing process and services ecologically sustainable and more sympathetic to the environment. Lean Principles are being increasingly adapted by firms and organization as they learn more about Lean principles and their benefits to achieve ecologically sustainable development.

Keywords: Lean, LPDS, TMC, end-of-pipe, Triple Bottom Line, Process-based, Integration and coordination, Net-work based, Value chain partners, Ecologically sustainable and Corporate Social Responsibility.

1. LEAN PRODUCTION DELIVERY SYSTEM (LPDS).

1.1. Introduction.

In old days product and services were imposed on customers. There were not many options available And Company's have survived on single very successful item with great success. But with the advancement of science and technology, the product range and choices have increased astronomically and there is a fierce competition in place in terms of choice, quality and value for money. In these modern customer

demand driven world the product life cycle has dramatically reduced paving the way for new, attractive and wide range of product and services to lure customers prompting the adoption of lean LPDS principle at a much faster rate in a wide range of environments such as manufacturing, service, healthcare and education.

In these competitive world customers wants product and services that will be tailored to their needs. Meeting

customer's wants and needs at its optimum level by the manufacturer or the service provider while being profitable there is no room for wastage in any form this is where secret of success of Lean management embarks on.

1.2. Origin of LPDS.

The story of Lean development began when one of Toyota manufacturing Company (TMC) employee (Taiichi Ohno) was studying and researching on American manufacturing methods in USA. He pointed out that US Manufacturing methods have two major flaws: (1). Producing components in large batches resulted in large inventories; and (2). The methods preferred large production over customer preferences.

TMC invested heavily to find a solution of these flaws came up with an alternative production technique integrating innovation and common sense well sited to Japanese culture. This idea of Toyota Production System (TPS) was documented in 1965 when the TMC rolled that system to its suppliers. The performance gaps between Western Car Manufacture and TMC after biggest oil crisis in 1773 prompted western Car manufacturer to learn about the secret of success of TMC.

The exploration of the Toyota model by Womack et al (1990) in his book "The Machine that Changed the World" convinced him to write that Toyota model can be transferred to non-Japanese culture with great benefits prompting US and European enterprise to adopt the model and reap the benefit. In this book Womack first coined the term "Lean" for Toyota Production System.

1.3. Lean Management Components.

Lean (Fig.1) must be viewed as a comprehensive system consisting of Leadership,

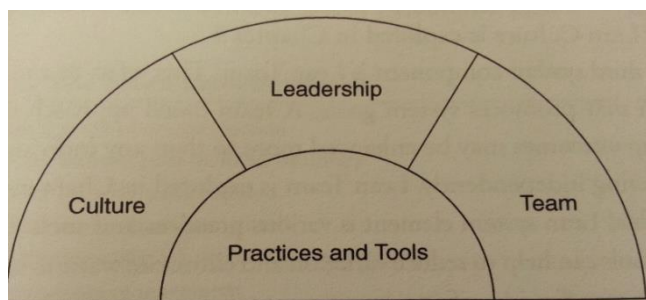


Fig. 1. Lean Management Components (Flidner, 2013).

Culture, Team, and Practices and tools (Flidner, 2013) not in isolation. Theses four key elements are similarly interdependent. Each of them impacts the other but Leadership is the keystone.

Lean leadership establishes the culture or environment necessary to achieve the improvement and waste elimination. Leaders must create the environment that stimulates changes.

Culture develops from behaviours that leaders reinforce. Organizational culture can either promote or hinder change.

2. LEAN PRINCIPLES.

The Lean philosophy has evolved surrounding the wasteful acts in an organization or enterprises, its identification and how they can be eliminated thereby reducing costs and maximizing revenue while satisfying customer needs. Lean philosophy is based on 7 principles as summarised by Flidner (2012) and are described below:

1. Eliminate waste of Overproduction
2. Eliminate waste of time on hand (waiting)
3. Eliminate time in transportation
4. Eliminate waste of processing itself
5. Eliminate waste of stock on hand (inventory)
6. Eliminate waste of movement
7. Eliminate waste of making defective products.

The lean is not a new concept they have simply been redeveloped or redesigned throughout history pioneered by Toyota.

3. LEAN THEORY.

It is already proven that Lean yield superior performance. Lean had its origin from automobile industry but its: power to improve performance; success to minimise waste; and its contribution to bring green revolution, lean is

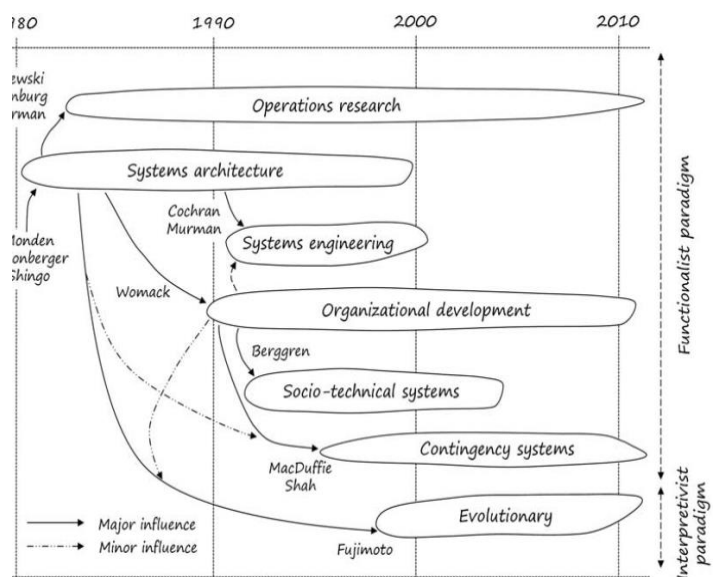


Fig. 2. Typology of Lean School of Thought (Hoss, Marcelo, 2013).



Now penetrating in many different industries in increasing number. Lean production theory can be summarised in five basic elements: (1). Precisely specify value by specific product; (2). Identify the value stream for each product; (3). Make value flow without interruption; (4). Let the customer pull value from the producer; and (5). Pursue perfection (Wu, 2010). Lean management is exceptionally successful in synchronizing group of individuals and function which are legally separate.

A Typology (Fig. 2) of lean school of thought has been put forward by Hoss (2013).

4. LEAN PRACTICES AND TOOLS

The availability of practices and tools are unlimited. The important aspect is to pick up the right tool for the right environment. Lean practice manager's imagination and creativity in solving problems is crucial for identifying and designing the most appropriate lean practices and tools. Not all Lean practices and tools are equally applicable in all types of environment. For example flexibility is keen for services in order to respond to varying demand.

Fliedner (2012) has compiled a list of tools and practices for lean success, which are reproduced below:

Standardization:- refers to a current best method, standardization means achieving the expected outcome using planned routine. Individual while being accountable should also be involved in sharing their knowledge.

Single Minute Exchange of Dies (SMED):- refers to rapid changeover.

Value Stream Mapping:-refers to visual inspection.

Kaizen and kaikaku Events:-look for localized process improvement and target radical change.

Production Levelling and Balancing:-examine production rate over time and aims to maintaining a constant ratio.

Visual Management Technique:-readily measure the current status and compares with the expected outcome thereby signalling the course of actions to be taken.

A3 Problem-Solving Report:-The name derived from paper size and the development A3 as a tool is attributed to TPS. It suggests a step wise orientation. A common 6-step A3 problem-solving procedure is outlined in Fliedner (2012, page 75).

Workplace Organization: 5S's:- tools are a set of sequential steps designed to improve efficiency, strengthen maintenance, and spotlight the emergence of issues and to promote continuous improvement (Bass, B M, 1990).

Spaghetti Diagrams:- it is a visual flow charting tool that uses a continuous line tracing that depicts the flow of work.

Cellular Manufacturing:-uses group technology to achieve greater flexibility in producing wide variety of parts or products.

Wellness Programs:- more recently recognises that people are the most important resources over machines.

Employee Cross Training:- Long term aim is to equip employees with multiple skills to be able to perform a variety of tasks.

Ergonomics:- takes care of safety and fitness between people and work place by taking into account Physical, Cognitive and Organizational Ergonomics.

Error Proofing: Jidoka, Poka-yoke, and Andon:- measure combined efforts of human and machine.

5 Why's:- is an effective tool in finding cause/effect relationship in lean management underlying a particular problem.

Lean tools help promote a common understanding of the current system state as well as to help direct improvement efforts of stable process.

5. CURRENT LEAN APPLICATION.

The originator of Pareto Principle associated with Lean Management was the famous Italian Economist Vilfredo Pareto. He has pioneered the introduction of Lean management in the healthcare industry.

5.1. Lean in Healthcare Industry.

Although the history, technology and culture in healthcare industry are different but the decisive factor is the managerial process which are alike for all industries.

Although the Lean management was developed for automotive industry but the universal call for Lean Management is value creation through elimination of waste and maximum utilization of resources by delivering premium customer service driven by customer demand and meeting their expectation. Lean principle aims to identify the wasteful activities that are common to all industry and healthcare industry in no exception (Teich and Faddoul, 2013).

Some of these wasteful activities are:

1. Overproduction:

Producing , buying or stocking something in excess of demand is a waste.

2. Inventory:

The maintenance of a large inventory requires: large storage space; frequent monitoring checking use by dates and larger manpower and all these acts costs money. It is proven that overall cost of smaller and more frequent shipments is lower than a large-volume purchase for which a discount was provided.

3. Motion:

A lot of walking waste can arise from poor design of working area.

4. Transportation:

Transportation of patients from one unit to the next or one hospital to the next, lab tests results and exchange of information, are an integral part of healthcare service.

5. Over-processing:

Over supply of materials whether its a claim forms, or medication or any other items freely available - are wasteful.

6. Defects:

Any service delivery outcome below the standard desired level may be termed as defects. For example, poor levelling of medical tests, incomplete information in patient's charts or in instructions provided to referrals.

7. Waiting:

Waiting in line for multiple hours to avail a service is a wasteful act.

8. Under Utilizing Staffs:

Under utilization of knowledge sharing and under utilization technical skills and creativity and not employing staffs to its maximum potential.

It was suggested that in order to implement lean in healthcare, the patient has to be the centre of the initiative, while time and comfort should be added as key performance measures in the system. Defining the patient as the primary customer requires a conceptual leap because usually the customer pays directly to the enterprise, whereas in healthcare third-party payments depending on the level of insurance are common (Teich and Faddoul, 2013).

Application of lean in healthcare industry began with reducing physical inventories in hospital and later extended to: Manufacturing-like studies; Managerial and Support Case studies; Patient-flow case studies and Organizational Case Studies.

Most of theses application (57%) was implemented in USA. The level of implementation took place in three levels:

1. Micro-operational Level outcomes represented by manufacturing-like, managerial and support, and patient-flow cases.

2. Meso-strategic Level focuses on financial health involving financial, staff morale and involvements.

3. Macro-outcomes of national initiatives such as the National Health Service plan in the UK (Young, 2008) .

6. LEAN CHALLENGES.

The birth place of LPDS was in Japan centring automobile manufacturing but they were not keen to extend it to other industries. Guimaraes (2012) speculates that it could be the result of either the lack of Japanese case publishing tradition or the fact that lean is naturally embedded in the Japanese culture and only the outstanding cases were published. On the other hand its application is steadily increasing in healthcare industry with in USA and Europe as evidenced by the increasing number of publications.

Young (2009) observed that some of the challenges in regards to lean implementation in healthcare are related to the concept of value, metrics and evidences. Bush RW (2007) on the other hand found evidences that healthcare in USA lacks efficiency, is not patient centred, does not provide timely services and is not equitable (the last two being related to many patients being under-insured). Redesigning such a system around values such as patients being "primary customers", emphasizing clinical and services outcome, using evidence based tools, and adopting, rigorous quality improvement methods may be a phenomenal challenge if it is imposed at the macro or even the meso strategic levels.

7. LPDS AND ECOLOGICALLY SUSTAINABLE DEVELOPMENT

7.1. Quadruple Bottom Line (QBL) Approach.

The concept of sustainability was first introduced in 1987 in a report entitled



Fig. 3a. Quadruple Bottom Line (QBL)



3b. Triple Bottom Line (TBL).

"Our Common Future" (Brundtland Commission Report). Prepared under the direction of United Nations by the World Commission on Environment and Development, the report sought to create a future which equally balanced economic, social and environmental needs, with the addition of governance. This is known as a Quadruple Bottom Line (QBL) approach (Fig. 3a). With this declaration in mind, sustainable development was defined as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Since the publication of Brundtland Report (Fig. 3b) the global awareness in achieving a sustainable world in individual, communal and national level is steadily increasing and actively participating in improving community's socioeconomic sectors.

Ecologically Sustainable Development (ESD) can be achieved through rational use, enhancement and conservation of resources so that ecological processes are maintained and the total quality of life continue to increase forever. ESD aims to meet the needs of today's generation and conserve healthy ecosystems for future generations. This requires prudent management and use of environmental resources which form the basis of the economy so that resources are not only maintained but where possible, improves their range, variety and quality and enhance sustainable growth.

7.2. Lean Principle and Sustainable Development.

The underlying philosophy Lean Principles (Fig. 4) are aimed at waste minimization which are already a great contribution towards sustainability. In that sense Lean and sustainability are integral cultural characteristics of an organization. It is clear that non-value adding activities are wasteful and unsustainable and must be minimized or eliminated. Process and operations must improve in order to become economically viable. Giant companies like Toyota, Ford, Walmart and others have now included sustainability as part of their corporate objectives. For example, Ford's vision for the 21st century is to provide sustainable transportation that is

affordable in every sense of the world: socially, environmentally and economically.

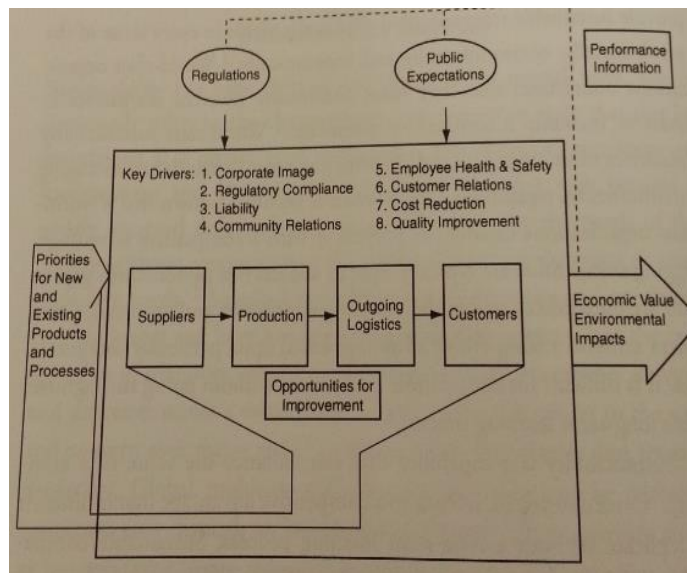


Fig.4. Flow chart showing economic drivers of sustainability (Fliedner, 2011).

World class organizations must embrace sustainability across the supply chain to conduct their business as they are main polluters of global environment. It is their first and foremost responsibility to look after our planet and Lean Management has taken the leading role with their commitment to eliminate wastage and adoption of other environmental drivers (Fig. 4) in their entire chain of production. Sustainability initiatives and their associated benefits evolved from lean management practice have been documented in much literature. Sustainability initiatives have focused on three broad categories: (1). Product and process life cycle considerations; Environmental Stewardship; and (3). facilities design, construction, environmental control, and maintenance.

7.3. Lean Management and the Environment.

Pollution Prevention, Pollution Control and Management System, all aims to control or eliminate the negative impacts on the natural environment through the implementation of closed-pope production strategy. The goal is to reduce or eliminate pollution at the source while generating benefits by cost cutting, less uses of raw material, recycling waste, and less uses water and energy.

The term lean production is integrated with just-in-time tactics in order to improve quality and delivery time. The relentless pursuit of waste minimization embedded in lean management practice opens doors for continued efforts in reducing the risk for the environment. The continuous effort through lean management to reduce operational waste, minimizing water

usage and consuming less energy translate into lower environmental harm, thus enhancing environmental performance (Hajmohammad et al, 2013).

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Product and Process life cycle aims to achieve sustainable development in line with triple bottom line principles through the employment of closed-loop-value chain system practices.

A change in the typical cradle-to-grave manufacturing model to a cradle-to-cradle approach, restore nature and eliminate disposal.

The adoption of eco-design concept has achieved eco-efficiency that encompass the concepts of dematerialization, increased resource productivity, reduced toxicity, increased recyclability and extended product life span.

Example, less packaging in shipping, Toyota's hybrid technology has achieved sustainable mobility.

Environmental Stewardship Initiatives compelled giant organizations to take social responsibility as a result of global warming, resource depletion, energy and water shortages, solid waste disposal and other environmental concerns. Toyota is increasingly using renewable energy, including biomass and natural energy source (solar and wind power), conserving environment by planting trees in and around manufacturing plants.

participation of Industry specific voluntary program such as EPA's 33/50 program and ISO 1400 EMS program and others.

Facilities: Design, Construction, Environmental Control, and Maintenance ??? Lean Management in its modern application consider very seriously design, construction and maintenance with an eye toward waste reduction and greater sustainability. One of the best examples is initiated by Bank of Americas new sky scrapper. It will use technology such as floor-to-ceiling insulated glass to reduce thermal loss and maximise natural light.

7.4. Lean Leading Environmental Innovation.

The demise of mass production, rapid globalization allowing access to reduced labour cost, changing market and strong global call to protect the environment has forced the companies to differentiate themselves within the market. Lean research revealed meeting customer expectations (Womack and Jones, 2003), adherence to more environmentally practices (Calvo et al, 2008), forcing lean to achieve three objectives: (1). develop an environmental innovation model; (2). Explain effectively the transformation process (Fig. 5) towards the new model; and (3). Demonstrate that the environmental innovation and transformation of a production system into a lean system is directed towards improving cost,

income, social responsibility and sustainability (Aguado et al, 2013).

In the following innovation model (Aguado et al, 2013) adapted pull methodology which allowed all actions to start from the final customer to the

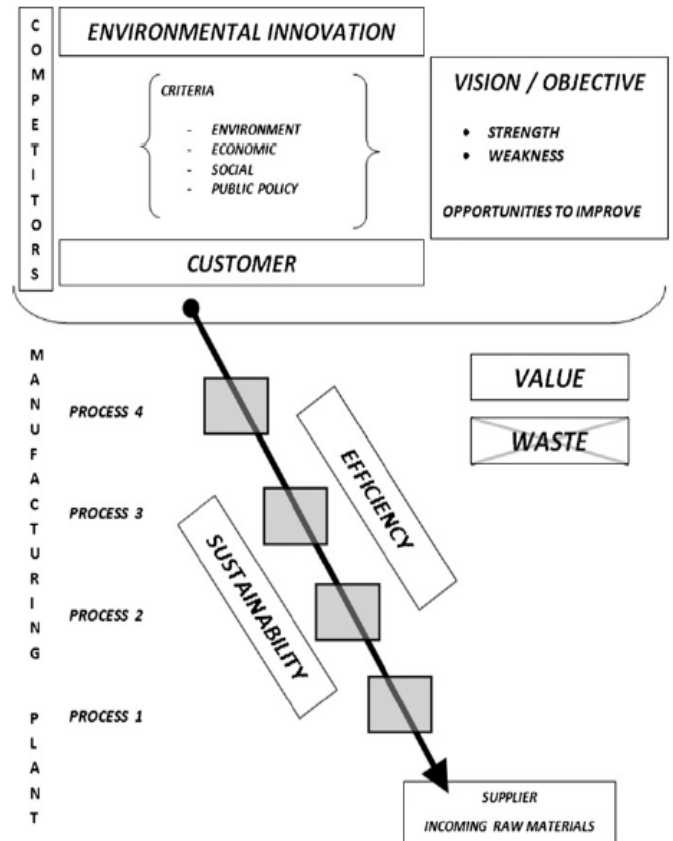


Fig. 5. Model of a sustainable lean production through process of environmental innovation (source: Aguado et al, 2013).

supplier of raw materials, accomplished through each intermediary operation of the production process (aguado et al, 2013).

7.5. Lean as a catalyst for Green Revolution.

Lean means waste reduction thereby reducing pollution. Lean means efficient use of Resources (and Energy). A commitment for lean meaning automatically setting a goal for successfully implementing green practices. Carvalho and Cruz-Machado (2009) explores the integration of lean, agile, resilient and green paradigms. Mollenkopt et al (2010) examine the relationship of green, lean and global supply chain strategies. Simpson and Power (2005) investigate the three main concepts of Lean manufacturing, environmental management practices,

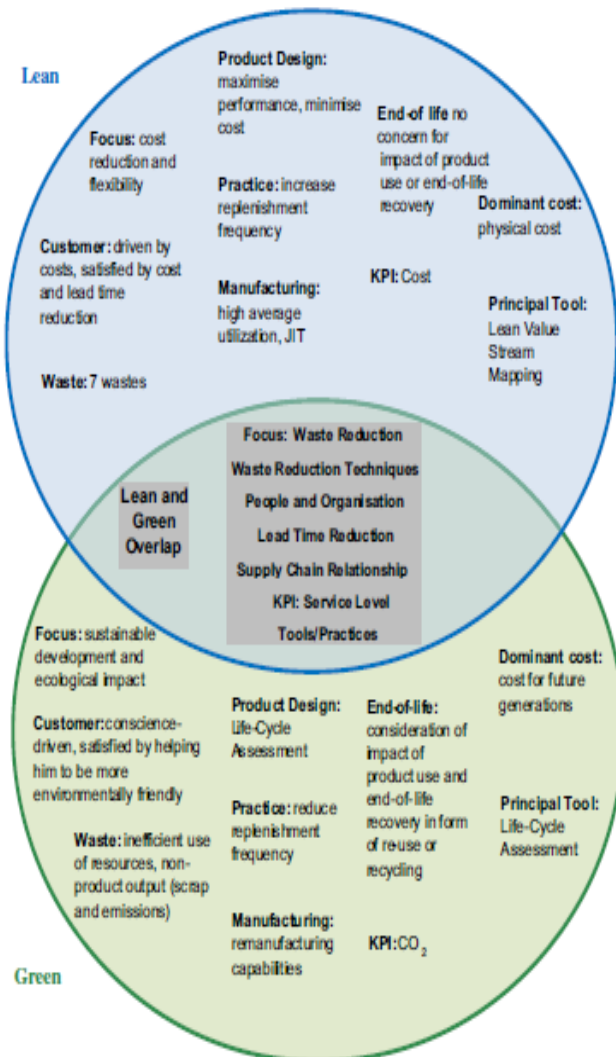


Fig. 6. Overlap of Lean and Green Paradigms (Source: Dues, Christina, 2013).

and supply relationship. Venkat and Wakeland (2006) analysed the environmental performance of lean supply using CO₂ emission as KPI. King and Lennox (2001) in their analysis provided evidence that ISO 9000 adopters are more likely to adopt the Environmental Management Standard ISO 14000. US EPA published a guide for environmental accounting.

Above mentioned pioneering works and many other research findings encouraged Dues et al (2013) to explore and establish empirical evidence to identify synergies between Lean and Green concepts. They have identified common Parameters of Lean and Green (Fig. 6). Their findings will remain as a milestone in achieving ecologically sustainable development.

8. CONCLUSION

The development of Lean Principles and mechanisms is a blessing in disguise for the entire globe. Extra special thanks to TMC for pioneering such principles which has brought revolution in ecologically sustainable development. Since then Lean is continuously improving and will keep improving by embracing technological innovation which are aimed at environmental sustainability. It is about time that the benefits of Lean Principles is spread out in every corner of the world and encourage every manufacturing and service enterprise to adapt Lean Philosophy. This way they will be able to deliver their social corporate responsibility in a very responsible manner which will not only bring material benefit for the enterprises but they will act as guardian angel for the planet. This practice will promote ecologically sustainable development, protecting our planet for future generations.

Closed pipe system of management (minimal or no wastage) is the future way to go and for Bangladesh where resource wastage is happening at an alarming rate. The adaption of LPDS technique must be implemented sooner than later and there is room for relaxation. To keep pace with the development boom that is happening in the industrial, infrastructural and other sectors waste minimization, recycle and reuse of resources to its maximum level is absolutely vital. Adoption of lean principle will do it all that is environmental protection, sustainable development and industrialization without damaging the virgin earth.

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