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LEAN MANAGEMENT SYSTEM IN SERVICE: A REVIEW OF SELECT LITERATURE

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Abstract

This study uses a selective literature review approach to analyze the lean management system implementation in different service verticals. It addresses three research questions that will help to map the lean management philosophy in the service sector. The analysis of literature found that lean management philosophy applied in manufacturing can be extended to improve service operational efficiency. Generalized mapping of five lean principles, seven basic wastes, and the effectiveness of various lean tools was established from a service perspective. This study would be useful for practitioners as well as a researcher to understand the basics of lean management systems in service verticals.

Keywords: Lean, Lean Management, Service verticals, lean waste, lean principles, lean tools.

1. INTRODUCTION

The service sector in several countries accounts for a significant portion of national GDP. However, the productivity of the service sector is mostly lesser as compared to the manufacturing sector (Manuel et al., 2012). The exponential growth of the service sector during the last few decades leads to more global competition. Service organizations need to improve their operational efficiency and effectiveness to achieve a competitive advantage. The operational efficiency improvement objective can be achieved through reduced cost, increased flexibility, lowered lead time, improved quality. Many service organizations are focusing on manufacturing principles like lean thinking to improve service productivity through improved operational performance. Lean thinking was introduced initially to the manufacturing domain; many lean tools and techniques developed over the period. Several lean tools were successfully implemented in manufacturing to reduce cost, improve productivity, reduce cycle time, etc. (Bicheno, 2004). Just as lean thinking helps manufacturing organizations to improve their productivity, the concept of lean thinking can be useful to improve service productivity as well. The service industries are lagging in implementing the operational improvement activities than manufacturing industries due to some of the inherent characteristics of the service industries (Pillai, Pundir and Ganapathy, 2012; Yuen and Thai, 2015). The biggest challenge for lean adoption in services is the intangible nature of the services and simultaneous production and delivery (Patwardhan and Patwardhan, 2008), as compared to the manufacturing of goods. However, lean management nowadays is extended to various service verticals like insurance companies, educational institutions, hospitals, IT industries.

Several papers are available in literature reviewing lean management applications in the manufacturing domain, as well as for the service domain. This paper is different as it attempts to map the basics of lean management philosophy with the service sector in the purview of its implementation. The lean management philosophy is based on lean principles, identification, and elimination of lean waste by using several lean tools. This paper attempts to map this philosophy concerning the service sector. This paper is arranged in the following manner. We first briefly describe the evolution of the lean or performance improvement philosophy over the last 200 years, the successful application of lean management philosophy to the manufacturing sector, its applicability to the service sector, and key research questions proposed in this paper. Then, we outline the research methodology adopted by us for this paper. We discuss the findings by reviewing the literature to our research questions in the next section. We conclude this paper with implications for future research.

2. EVOLUTION OF LEAN MANAGEMENT PHILOSOPHY

Lean management philosophy mostly focuses on operational improvements to achieve productivity improvement. However, performance improvement activities are not new to the manufacturing community; the parentage of the performance improvement goes back to Eli Whitney for his concept of interchangeable parts. Eli Whitney, in 1799, developed the concept of interchangeable parts for muskets manufacturing. In the next 100 years, many manufacturers developed their own technologies for performance improvement. Frederick W. Taylor started his work around 1890 as an industrial engineer, focusing on workers productivity and work methods. The outcome of his study is the classical time study and standardized work; he termed his contribution as scientific management. Frank Gilbreth developed a motion study around 1920, which helps in reducing motions of the hand. He also developed various process charts to understand the process operations. Taylor's work was primarily concerned with reducing process times by establishing time standards. Frank Gilbreth, in contrast primarily concerned with making processes more efficient through reducing various motions involved.

Henry Ford introduced a continuous flow concept applicable for assembly lines, which reduced the assembly efforts by almost 90 %. (James P. Womac, 2003). During world war-II, Ford's willow run concept helped the US army by providing B-24 bomber planes at a faster production rate. (Holweg, 2007). From 1949 to 1975, the Toyota Motor Corporation carried out many successful activities to improve their productivity with better quality. Toyota peoples like Taiichi Ohno, Shigeo Shingo introduces the concepts like "Just in Time," "Single Minute Exchange of Dies," "Seven Manufacturing wastes" to the world through their unique Toyota Production System. Around 1980, American industry General electric introduced the concept of world-class manufacturing. James Womack first used the concept of Lean manufacturing in his book, "The machine that changed the world"(Womack et al., 1990). In their pioneering paper, (Bowen and Youngdahl, 1998) extended the lean ideas to services applications in Taco Bells, SW airlines, and Shouldice hospitals(Gupta et al., 2016). Around 2000 the concept of lean six sigma evolved (George, 2003) suggested application of lean six sigma in services. Around 2012 the concept of Industry 4.0 was introduced in Germany. The concept of Industry4.0 is mainly based on Cyber-Physical Systems (CPS), which synchronizes the physical factory floor and the cyber computational space(Lee et al., 2015). In the present situation, most of the industries try to incorporate the concept of Industry 4.0 in their productivity improvement activities, IBM is one the pioneer in doing this with the use of internet of things.

Lean applications in the industry initiated with the introduction of the Toyota Production System (TPS). Ford and Toyota Motor Companies are the first who successfully implemented lean in their manufacturing plants (Holweg, 2007). Around 1990, the lean manufacturing concept successfully implemented by almost all the manufacturing areas such as chemicals, aerospace, electronics (Pepper and Spedding, 2010).

3. LEAN MANAGEMENT SYSTEM IN SERVICES

The research related to a Lean management system (LMS) in services started around 1998. However, various performance improvement tools were used earlier in the service sector. Around 1984 G. Lynn Shostack suggested the concept of "Service Blueprint", which helps service organizations to identify all the issues related to service management (Shostack, 1984). In order to understand customer perceptions about service quality in service and allied organizations (Parasuraman et al., 1988) develops 22 items SERVQUAL. Still today, no generalized approach is available to implement a lean management system in services. The significant challenges in applying LMS in the service sector may be the lack of awareness about the benefits of implementing LMS, approach to initiate LMS implementation process and some unique characteristics of services such as intangibility, heterogeneity, inseparability, simultaneity, and perishability; Lovelock and Evert, 2004; Ladhari, 2009. The presence of the customer in the service delivery system can make LMS implementation difficult in service organizations (George, 2003). Since a few decades, several efforts were made to use a lean management system in service organizations by various researchers. The Indian software company, Wipro, launched its lean initiative in 2004, initial lean adoption shows more than 10% improvement in efficiency in many lean projects (Huckman et al., 2009). LMS in healthcare can significantly contribute to value creation by eliminating several nonvalue added activities (Al-araidah *et al.*, 2010; Chaurasia, Garg and Agarwal, 2017) explores the Lean Six Sigma application in Indian healthcare processes (Papadopoulos et al., 2011) discussed the use of actor-network theory to explore process improvement dynamics for lean implementation methodology complex settings of the healthcare organization. Lean (Antony, 2014) described various essential readiness factors required

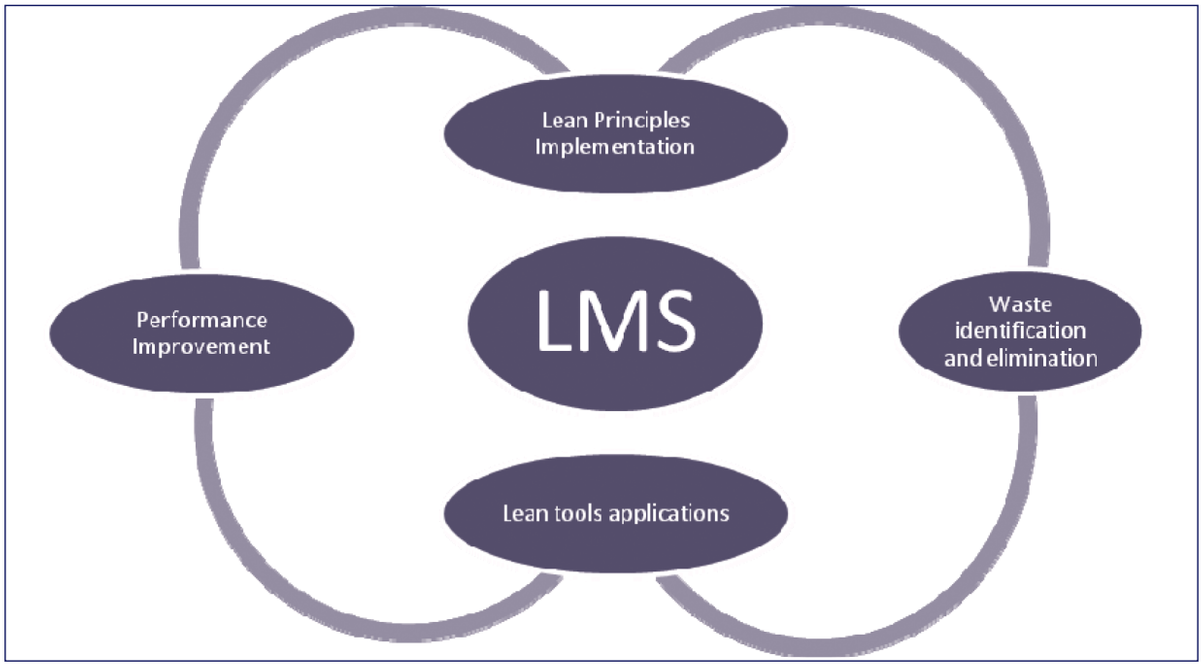

Fig.1 Lean Management System Research Areas

for the successful introduction and development of a Lean Six Sigma initiative for the higher education sector. In healthcare (Bhat et al., 2014) developed a methodology for lean six sigma deployment in Indian healthcare. (Rauch et al., 2016) discussed the implementation of the lean management system (LMS) in the hospitality sector and discussed the suitability and its potential for optimizing the hospitability processes. In this work, he discussed a case study of one hotel where several lean tools have been successfully used to optimize the hotel process.

Lean Management System (LMS) is successfully used in various service organizations as a performance improvement initiative. The primary focus of LMS is on lean implementation by applying five basic lean principles, identifying the various waste present in the system, and applying suitable lean tools for improvement. In research objective of lean implementation can be achieved through the ways shown in Fig.1

4. RESEARCH METHODOLOGY

The primary objective of this paper is to discuss a few key research questions related to the implementation of a lean management system in the service sector, to identify present literature gaps and to identify opportunities for future research. In order to achieve the above objective, this paper addresses the following research questions.

Research Question 1: How Lean manufacturing principles mapped with services?

Research Question 2: How seven types of wastes defined by Taichi Onho mapped with services?

Research Question 3: How lean tools are useful in improving service operations?

In this paper, we have used a selective literature review process adopted by (Cronin, Ryan, and Coughlan, 2008; Bryson, Berry and Yang, 2010; Daultani, Chaudhuri and Kumar, 2015). This paper aims at highlighting the importance of a lean management system in services through critical analysis of available literature. This paper includes the literature from the systematic evolution of the lean management system from its inception to its applications in service sectors.

In this paper, we included research papers from various journals and reputed international conferences as well as books which outcomes added to the existing body of theoretical knowledge. Mostly the literature from the peer-reviewed journal is considered published in the English language only Multiple online databases searched including Emerald, Google Scholar, Science Direct, Pro-Quest, EBSCO Information Services and Web of Science using the keywords, “Lean management in services,” “Lean thinking for services,” “Lean principles in service,” “Lean tools for Services.” The literature included for study in this paper is mainly from 1998 to 2017 period. This search provides a comprehensive set of papers. In this study, a total of 73 papers selected from the available literature which are relevant to the research questions addressed in this paper.

5. FINDINGS AND DISCUSSIONS

5.1 Research Question 1: How Lean Manufacturing Principles mapped with services?

The five fundamental principles for implementing a lean management system are value, value stream, flow, pull, and perfection (James P. Womac, 2003). Value is something for which customer is ready to pay or something that makes product or service fit for the intended function. The value stream is the particular order of various activities which are needed to provide product or service to the customer. Flow means the completion of activities along the value stream, avoiding waiting or delays. The pull principle refers to producing an upstream process only if there is a requirement for the downstream process. The principle of perfection focuses on the complete elimination of waste and creating only value-added activities (James P. Womac, 2003).

Many researchers have put enormous efforts to apply and map these principles to the service domain. The significant research is in service domain related with these principles such as (Allway and Corbett, 2002), (Ahlstrom, 2004), (Liker and Morgan, 2006), (Abdi et al., 2006), (Wei, 2009), (Pillai et al., 2012), (Carlborg et al., 2013), (Loukas and Alexandros, 2016), (Gopalakrishnan and Anand, 2017) which adds to the existing body of knowledge is listed in the table below (Table. 1).

From the above literature, it is observed that most of the authors suggested that lean principles apply for a specific service domain. Staats et al. (2011) Identified significant challenges for lean implementations, carry out descriptive analysis to examine how to overcome these challenges, and developed a framework for lean implementation in the knowledge industry. In 2002, Virginia Mason developed the “Virginia Mason Production System (VMPS)” for healthcare delivery to improve patient safety and healthcare service quality. VPMS mainly based on the five basic lean principles (Dana and Carol, 2007). Lean management principles can be successfully implemented in the emergency department of a healthcare unit to improve the patient’s flow, reduced time spent by the patient to achieve higher patient satisfaction (David et al., 2010). Lean management systems principles are applied to almost all services verticals to improve customer service by eliminating wastes(Bowen and Youngdahl, 1998). Service verticals where lean principles have been successfully implemented are software (Staats et al., 2011; Poppendieck, 2011; Pernstal et al., 2013), healthcare (Dana and Carol, 2007, Jimmerson et al., 2005), education (Dahlgaard and Ostergaard, 2000; Emiliani, 2004), commercial management (Zimina and Pasquire, 2011), banking and insurance (Delgado et al., 2010) etc.

Service systems are different compared with manufacturing systems due to this. The five fundamental principles may not always explicitly applicable to service systems (Maleyeff, 2006). However, the thorough analysis of available literature can provide a generalization of the lean principles in service domain in the following way (Table: 2)

Table 1: Lean principles in Services

Authors and Year	Major Contributions
Allway and Corbett (2002)	Designed the five-phase process for lean implementation in an insurance company.
Ahlstrom (2004)	Discussed how lean philosophy is applicable in-service domain.
Jimmerson et al. (2005)	Applied lean principles and tools to various healthcare processes to address critical healthcare challenges like medical errors, increased healthcare costs, and shortages of healthcare staff.
Liker and Morgan (2006)	Discussed how TPS (Toyota Production System) principles can be applied to service processes, through a systems approach to integrates people, processes, and technology.
Abdi et al. (2006)	Discussed the lean principles and explained differences and similarities from a service point of view.
Wei (2009)	Proposed ten Lean principles of service process design.
Poppendieck (2011)	Developed a framework for the application of Lean principles to software development.
Pillai et al. (2012)	Proposed a framework for implementing lean six sigma in the software development process, to substantially improve the productivity, reduction in cycle time with speed and consistency.
Carlborg et al. (2013)	Discussed different obstacles, for implementing lean management system principles in the service sector in order to standardize service and to increase the reliability of service processes.
Loukas and Alexandros (2016)	This study proposed various critical success factors (CSFs) for lean six sigma implementations to service domain.
Gopalakrishnan and Anand, (2016)	This study proposed lean assessment framework for healthcare organizations.

Table 2: Mapping of Lean Principles with Services

Lean Principles	Manufacturing	Service
Value	At each manufacturing, step value can be identified with a predefined goal.	Difficult to identify, can be assessed through customer experience.
Value Stream	Consist movements of Parts and materials flow.	Information and Knowledge flow.
Flow	External interruptions in flow cause waste.	Simultaneous production and consumption.
Pull	Driven by takt time.	Driven by the organization's need.
Perfection	Process without rework or defects.	The process to provide a better experience at each touchpoint.

5.2 Research Question 2: How seven types of wastes defined by Taichi Onho mapped with services?

The basis of the lean management system is to enhance value to the customer. Customer value can be enhanced by providing more value-adding features, preferably at the same cost to the customer, and the other way is to reduce non-value adding features (Hines et al., 2004). Anything that does not add to the value is termed as waste. Identifying and eliminating these waste is the most crucial aspect of lean management system implementation (Hicks, 2007). The most fundamental aspect of lean management to understand what is the waste so that it can be effectively targeted and eliminated by selecting proper lean tools. Taiichi Ohno identified the initial seven wastes for the manufacturing domain. These wastes consist of Transportation, Inventory, Motion, Waiting, Over-processing, Overproduction, and defects. In recent literature, the unutilized human resource also termed as eighth waste. In the present study, we do not consider this waste for mapping, as it may be inevitable in many service domains. In order to achieve excellence in any operations, one must focus on the elimination of waste from the processes (James P. Womac, 2003). Over the last two decades, these wastes were extensively identified and successfully eliminated in manufacturing operations and production environments in almost all the manufacturing verticals. Dahlgaard and Ostergaard, (2000), identified eight types of waste in higher education necessary to implement lean philosophy in the education sector. NHS Institute for Innovation and Improvement, Warwick, mapped manufacturing waste with healthcare wastes. (Poppendieck, 2011) (Pernstal et al., 2013) describe the relationship between initial manufacturing waste with the software development process. (Pillai et al., 2014) identified major wastes present in systemized transactional processes of software development, these wastes include overproduction(more transactions in the process), overprocessing (presence of several nonvalue-added activities), waiting(time gaps between value-added activities), ownership issues, unnecessary movements and underutilization of people. Lean service wastes can be termed as "Service Design" waste, "Service Item" waste, "Service Ability" waste, "Service Process" waste, and"Service Delay" waste, which is based on the service value stream map (Li and Ma Man, 2011).

(Maskell and Kennedy, 2007) suggested some waste presents in accounting. (Hicks, 2007) maps seven cardinal wastes with information management. (Sternberg et al., 2012) developed a framework which maps 7 lean waste for motor carrier operations by qualitative analysis through literature review and an expert interview.

5.2.1 Transportation

Transportation waste refers to the unnecessary movement or motion of materials, like work in the process shifted from one workstation to another workstation. Transportation needs to be minimized as it increases the processing time without adding value to it. In some cases, excessive material handling may damage the product. In the case of service domain, this waste may vary as per the service vertical (Poppendieck, 2011) maps transportation as handoffs in software development, meaning transforming work to the immediate customer without properly understanding his requirements. Loss of momentum, information, and accountability in product development occurring due to unnecessary information transfer or diffusion of the decisions is similar to transportation waste in manufacturing (Pernstal et al., 2013). National Health Service institute Warwick maps unnecessary movements in search of equipment through the hospital as transportation waste in lean healthcare (David et al., 2010) added that unnecessary material moving around the hospital as waste. From the literature, the common thing about transportation waste in the service sector is that it involves the unnecessary transformation of certain activities like information or the material required to provide the service.

5.2.2 Inventory

In manufacturing the inventory waste normally referred to as excessive storage of unwanted raw material, great work in process, or finished goods. This inventory also requires additional handling and space. Its presence can also have incurred additional handling and processing cost. Most of the service operations are initiated with the customer order, so identification of inventory waste becomes a little difficult. However, in the case of the healthcare National Health Service Institute, Warwick described excess work in progress, excessive stockpiling of materials (David et al., 2010), or even information or patients waiting in a queue can be termed as inventory waste (Dana and Carol, 2007). Unprocessed or unused information or material can be called inventory waste in product development (Pernstal et al., 2013).In software development written requirements about software features or spending time on tracking change, control is equivalent to inventory waste (Poppendieck, 2011). In general, the definition of inventory waste may vary among different service verticals. However, in order to map inventory waste, we can have generalized it as any unnecessary accumulation of material or information which does not add value to the service.

5.2.3 Motion

Motion waste refers to the unnecessary movements done by employees or equipment to complete the desired activity or work. In any operation, excessive motion takes more time to complete the task and not adding any value to it. In the case of service, this waste can occur in the form of unnecessary employee or information movement, additional motion due to improper service layout, etc. In product development, we can see redundant review meetings, the unnecessary distance between program members leading to inefficient information transfer is similar to motion waste in manufacturing (Pernstal J., 2013). In software development, when wastage occurs due to search for the information is equivalent to motion waste (Poppendieck, 2002). In healthcare, excessive movement by workers for the patient service movement of equipment is similar to motion waste (David et al., 2010). In order to generalize this, we can term motion waste as excessive movements of staff or information for the service execution.

5.2.4 Waiting

Waiting refers to the inactiveness of a downstream process due to non-delivery of upstream activity in the required time. In some cases, waiting may result in the overproduction of downstream activity. In the service sector environment, this waste may occur due to waiting for an operator, people, or equipment needed to provide a specific service. In healthcare, whenever a service provider has to wait for people, equipment, or information causing delay to the process, their work is called waiting type of waste as per NHS and (David et al., 2010). Delays by the healthcare service provider for paperwork, testing equipment search, test report search is termed as waiting type of waste in healthcare by NHS. Waiting for reviews, decisions, permissions, or information in product development is analogs to waiting waste of manufacturing (Pernstal J., 2013). (Poppendieck, 2002) added waiting by the customer for software delivery as waste in software development. In general, in the case of service sector inactiveness of the service operator due to delayed information, delayed stakeholder response, or delay in decision process leads to waiting waste.

5.2.5 Over Processing

Over-processing refers to any extra operation like reprocessing, rework, excessive processing, or handling without adding value to the product or service. In healthcare, NHS mentioned that duplication of patient information, repeatedly taking patient history as well as nonvalue-added work steps as over-processing in healthcare (David et al., 2010). Unnecessary tasks in design or non-using standardized components in the design are similar to over processing (Pernstal J., 2013). Adding too many steps in software development leads to over processing (Poppendieck, 2002).

5.2.6 Over Production

In manufacturing, producing what is unwanted or earlier than it needed is called overproduction. This may occur because of continuing upstream operations without considering the downstream requirement. In a service environment, the overproduction term may be treated in a different in various

service verticals. In software development, providing extra features not required by the customer is equivalent to overproduction (Poppendieck, 2002). Unnecessary pathological tests or unnecessary checkup is overproduction in healthcare as per NHS guidelines, creating more work than required is termed as overproduction in healthcare(David et al., 2010). In product development, doing extra activities not needed for a subsequent step or developing additional features without adding to customer value is overproduction (Pernstal J., 2013). In general, we can say unnecessary activities done for service execution termed as overproduction in the service sector.

5.2.7 Defects

In manufacturing, anything resulted in rejection or rework is a defect. If any product or service that does not meet the required specifications needed as per customer's expectation termed as defective. A defective product or service causes customer dissatisfaction. In healthcare, NHS defined adverse drug reactions, readmission, failed surgeries as errors or defects. Any preventable work, when carried out to correct the product development process, is a defect (Pernstal J., 2013). When the software test fails to capture the defect, and it gets transferred to the customer, causing extra work is similar to a defect in manufacturing (Poppendieck, 2002). Thus, simply the errors in service execution can be treated as a defect type of waste in the service sector. A comprehensive literature analysis provides a base for generalizing the mapping of the manufacturing waste to the service sector. The generalization of the waste in the service sector is shown in the following table (Table3).

Table 3 Mapping Lean wastes with Services

Waste	Manufacturing Description	Service Description
Transportation	Unnecessary movements of material or product.	Unnecessary transfers of information or service providers.
Inventory	Excessive storage of raw material or WIP.	Unnecessary accumulation of materials or information.
Motion	Unnecessary workers movement.	Excessive movements of staff during service execution.
Waiting	Waiting for materials, equipment, further operation.	Waiting for information, stakeholder, or decisions.
Over Processing	Unnecessary non-value adding operations on product.	Unnecessary duplication of information.
Over Production	Producing excess than needed or earlier than it needed.	Carrying unnecessary activities which are not needed during service execution.
Defects	Imperfection in product production.	Errors in service execution.

5.3 Research Question 3: How lean tools are useful in improving service operational efficiency?

Lean tools and techniques play a very vital role in lean implementations across any organization. In more general terms, the implementation of principles of the lean management system and the elimination of various waste achieved through the proper application of the lean tool. Lean tools used in manufacturing can be applied to the services sector. Since the last two decades, several lean tools and techniques have been developed, presently, more than 100 different tools are available for lean implementation (Daultani et al., 2015). Most of the tools for implementing a lean management system in the service sector are used in combinations. In order to classify lean tools (Pavnaskar et al., 2003) developed a structured seven-level scheme based on system, object, operation, activity, resource, characteristic, and application. However, for healthcare (Robinson et al., 2012) classified lean tools into three categories as assessment tools, improvement tools, and monitoring tools. To define and document the process status and to use different performance measurement systems assessment tools are used. Improvement tools are used to initiate continuous process improvement to cater to the desired condition. In order to observe, check, and sustain improved performance, the monitoring tools are used.

Table 4: Classification of Lean Tools (Modified from : Robinson et al., 2012)

Assessment Tools	Improvement tools	Monitoring tools
VSM	Single piece flow	Statistical Process Control
Root-cause analysis (A3 reports, Fishbone diagram)	Kaizen/Rapid Improvement Event	Pareto Charts, Check Sheets, Scatter Diagram, Histogram, Control Charts
VOC, VOB, CTQ	Process Reengineering	Kanban, Visual Signals
Takt time	Work Cells	Mistake Proofing (Poka-yoke,)
Benchmarking	Quick Changeovers (SMED)	PDCA
Spaghetti map	Heijunka (Load Levelling)	PDSA
Risk Analysis (FMEA)	Kanban, Visual Signals	5S
SIPOC analysis	Mistake Proofing (Poka-yoke)	Jidoka
Gemba	PDSA	
ABC Analysis	5S	
Process Mapping	Jidoka	
5S		

Value stream mapping is used most frequently as it is useful to eliminate nonvalue-added activities and cardinal waste from the processes. (Hines and Rich, 1997) developed seven different VSM tools connected with seven wastes. These seven VSM tools termed as process activity mapping, supply chain response matrix, production variety funnel, quality filter mapping, demand amplification mapping, decision point analysis, and physical structure mapping, out of the above tools process activity mapping tool is used frequently in services.

The selection of a specific tool from the available tool is a challenging job. Improper application of lean tools may lead to deteriorating service performance. (Simon and Canacari, 2012) has given some guidelines about the usefulness of different tools and stages during which they were applied. In the case of health care settings, (Vinodh et al., 2012) developed the analytic hierarchy process (AHP) model, which helps to rank different tools according to their priority for application in a particular situation.

Several tools, techniques, and methodologies were used extensively in the literature. Many tools were successfully applied in the service domain to eliminate service waste and to implement a lean management system in the service sector. A Value stream mapping tool is mostly applicable to all service verticals few of them are, application of VSM in healthcare (Laganga, 2011; Lummuset. al., 2006), for insurance (Swank, 2003), for finance (Delgado et al., 2010), for call center (Laureani et al., 2010), for software (Staats et al., 2011) and for education (Isaksson et al., 2013). Five S is one of the Japanese tools. 5S is a handy tool for organizing the workplace. 5s can form the base for further lean management system implementation. In service organizations, this tool is also used by several researchers like for education (Emiliani, 2004), for insurance (Koning et al., 2008), for public service (Manuel et al., 2012) etc. Voice of the customer (VOC) is the in-depth process used to capture customer's expectations, preferences, comments, of a product or service. This is also useful tool in service domain it has been used by many researchers in various service verticals like for healthcare (VanLeeuwen and Does, 2010) (Aghlmand et al., 2010), for finance (Delgado et al., 2010), for call center (Laureani et al., 2010), for software (Malladi et al., 2011; Staats et al., 2011). There are several other tools also like Failure mode and effect analysis (FMEA) (Latino, 2004; Ookalkar et al., 2009), Kizen (Baril et al., 2016; Norazlan et al., 2014), Single minute exchange of dies (SMED) etc also shown their application in lean management system implementation in service sector. The successful application of a few lean tools in the service sector is listed in the table below. (Table 5)

Table 5: Lean tools in Service Sectors

Lean Tool	Service Verticals	Author	Contribution
VSM	Insurance	Swank (2003)	Reduced process time, labor cost and errors
	Healthcare	Lummus et al. (2006)	Reduces patient waiting time and increase patient throughput
	Finance	Delgado et al. (2010)	Productivity improvement through serving more number of customers
	Call center	Laureani et al. (2010)	Streamline the process, Reduced operator turnover
	Healthcare	Laganga (2011)	Waiting time reduction, accessibility improvement
	Software	Staats et al. (2011)	improved operational performance
	Education	Isaksson et al. (2013)	Knowledge delivery time reduction,
5S	Education	Emiliani (2004)	Improved relevance of course materials
	Insurance	Koning et al. (2008)	Streamline the process
	Public service	Manuel et al. (2012)	Space reduction Improvement in processes and services
VOC	Healthcare	VanLeeuwen and Does (2010)	Helps in reducing the length of patient stay in the hospital, which helps in increasing bed availability and cost reduction
	Finance	Delgado et al., (2010)	Productivity improvement through serving more number of customers
	Call center	Laureani et al., (2010)	Streamline the process, Reduced operator turnover
	Software	Malladi et al. (2011)	Results in efficiency improvement through, continuous improvement, to enhance productivity
	Software	Staats et al., (2011)	improved operational performance
	Healthcare	Aghlmand et al. (2010)	Identified customer segment, need analysis competitor analysis for maternity hospital
FMEA	Healthcare	Latino, 2004	To increase patient safety in hospitals
	Healthcare	Ookalkar et al. (2009)	To reduce process errors, mitigate overall risks for effective patient care in the hemodialysis process.
Kaizen	Healthcare	Baril et al. (2016)	To improve patient's trajectory in an outpatient clinic. Patient delays were reduced by 74 percent after 19weeks.
	Healthcare	Norazlan et al. (2014)	To investigate the relationship between kaizen blitz and sustainable performance for the Malaysian healthcare industry.

VSM=Value Stream Mapping, VOC= Voice of Customer, FMEA= Failure mode and effect analysis

The successful Lean Management System implementation leads to various outcomes in different areas associated with service operations. The outcome of the successful lean tool implementation in the service sector may result in one or more of the following areas Fig. 2.

Fig. 2 Lean Management Implementation Outcome

6. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

In the last two decades, lean management implementation has gain importance in the service sector around the world. Lean management system application in the service sector is different as compared to manufacturing because of some distinctive features of the services. The awareness about the lean management system implementation was increased in the service sector; however, its potential is not yet explored entirely among all service verticals. Several tools and techniques were developed over a while, and these tools are useful to identify and eliminate waste. This will help to improve service quality and customer experience significantly. There are still many unaddressed issues to expand the body of knowledge of the lean management system in the service sector. Literature does not provide a generalized approach for lean implementation, in particular, service vertical. This paper may help researchers and practitioners to adopt a step by step approach to implement lean management philosophy in the service sector. In literature, it has been discussed about the successful lean implementation while the critical success factors for the same was not addressed. Further study is required to address the factors influencing lean implementation in services. The most crucial aspect of lean implementation is to study its impact on organizational performance. In literature, no such performance measuring tool or technique is available for the service domain. However, in the manufacturing domain (Gupta et al., 2013) proposes a waste centric approach to evaluate lean performance for the radial tyre industry. Several tools and techniques for lean management system implementation are discussed in the literature, but no methodology is available to select appropriate lean tools in specific situations. An extensive study is required to analyze the effectiveness of lean tools for a particular situation concerning any service processes.

In review, the sustainability aspects of lean in the service sector are not studied in detail. The impact of lean management system implementation on environmental issues needs to study in detail. However, (Gupta et al.,2017) present a system dynamics model approach to assess the environmental impact of a radial tyre manufacturing unit. This type of approach can be useful in the service domain, as well. In our analysis, an attempt has been made to map basic lean management system principles with services. We have attempted to define seven types of waste which can apply to any of the service vertical. Different

lean tools and techniques which can help lean implementation in services were identified. It has been found that many tools that can be used in the manufacturing domain can significantly be useful in-service domain also.

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