

# *A Literature Review And Research Agenda Of Value Stream Mapping Addressing Study Population And Sample Design*

Kunyorija Ogora Joseph

Ph. D Student (Doctor of Philosophy in Operations Management),

Department of Management science,

School of Business and Economics,

Maseno University, Kenya

kunyorijaj@gmail.com



**Abstract** – The Purpose of this literature review is to provide a taxonomy of value stream mapping research and, based on that, to develop a research agenda for this field of study in relation to study population and research design. The proposed value stream mapping research classification framework is based on a comprehensive literature review, which concentrates on peer-reviewed journal papers published within the period 2002-2020. A total of 83 academic sources have been retrieved and analyzed in terms of research purpose and nature, methodology employed, theoretical approach and level of analysis. The review reveals that value stream mapping research is empirical-descriptive in nature and that it generally lacks a sampling design foundation and a tin study population. It identifies certain knowledge gaps and develops six propositions for future research. It suggests that focus should be directed towards more conceptual model, mathematical model, interviews, empirical triangulation (mixed methods) and simulation based studies. It also argues that further empirical research in relation to value stream mapping in relation to study population and sample design is needed. This paper fulfills an identified need for a comprehensive classification framework of value stream mapping studies. It essentially provides both academics and practitioners with a conceptual map of existing value stream mapping research and also points out opportunities for future research.

**Keywords** – Value stream mapping, Study population and sampling design Third party vendors, Distribution management.

## I. INTRODUCTION

In today's highly competitive, extremely variable and really dynamic environment, many firms are seeking solutions in all areas of their activities, also including, or perhaps above all, value stream mapping. The concept of value stream mapping was introduced in Japan, and the Toyota production system was the first to use lean practices. Lean manufacturing helps in enhancing production processes and boosting up the employees job satisfaction (Singh *et al.*, 2010c). As the Lean movement picked momentum, consequently this mapping technique that Toyota had designed and gradually evolved to become what is known as value stream mapping, which is much more suitable and appropriate for businesses and value streams of all types (Rother and Shook, 1999; Yuvamitra *et al.*, 2017).

Value stream mapping looks at the current prepared state and address section of change through three approaches: prepare adjustment; disposal of superfluous action and action advancement (Ciarapica *et al.*, 2016; Kuiper *et al.*, 2016). The basics to actualize value stream mapping are to draw a current state map portraying the existing process, find conceivable changes and elevates and develop action plan to reach a future state map outlining the continuous improvement (Forno *et al.*, 2014). Moreover value stream mapping provides the practitioner with a common platform to assess the current state and advance the production process (McDonald *et al.*, 2010).

As production cost essentially depends on the speed of product flow through the value stream, value stream mapping can be critical as an appropriate tool to link between operational and financial organizational views. (Ramadan *et al.*, 2017). Value

stream mapping can be embraced in various measurements including production Schweizer (2011), industrial logistics Knoll (2019), software development Bin *et al.*, (2016), pharmaceutical Chowdary and George (2012), health care Snyder *et al.*, (2005) and service industry Tyagi and Vadrevu (2005) & Morlock and Meier (2015).

Currently value stream mapping in any sort of industry contains has a direct outcome on manufacturing processes. Presently individuals have various perspectives on manufacturing processes. They appreciate that the value of a product is defined from the customer's viewpoint, not from an internal manufacturing perspective. Value stream mapping emphasizes on the elimination of wastes from the organization. This organized literature review focuses on value stream mapping and the depiction of the discipline, by synthesizing critical information from scholarly journals, examining study populations and sampling design. On the other hand, information regarding year of publication, publishers, and university and author associations are analyzed. A variety of databases from 2002 to 2020 containing the keyword "value steam mapping" in their title and/or abstract, portrayed this study and bears a comprehensive posting of value stream mapping journal articles. Full bibliographic particulars of the 50 reviewed articles are included within the reference section to demonstrate the straightforwardness of the research to depict an independent orderly assessment. These published articles were characterized and classified as per their sampling design. In addition, the articles were further analyzed within a database generated in Microsoft Excel.

There's directly need of a comprehensive literature reviews that investigate and look at the expanding body of literature in value stream mapping. The need for such a comprehensive and expanded literature review is additionally proposed by Bhim Singh *et al.*, (2010). Subsequently, this study focused on analyzing and answering to questions on the current status of research, future designs, and especially endeavors to answer the following question:

RQ 1. What have been the different types sampling designs and study populations adopted to evaluate the practice of value stream mapping?

The reactions to this question will empower the development of an in-depth literature review, and assistance to future research and exploration in the discipline. To address this, the researcher started with a comprehensive examination of the existing literature on value stream mapping before presenting the methodology and results of this study.

## **II. OVERVIEW OF VALUE STREAM MAPPING**

Rother and Shook (2003) value stream is a collection of all activities comprising of value added as well as non-value added that are expected to bring a product or a group of products that use the same resources through the main flows, from raw material to the end customers. Value stream mapping can be traced back to more than 30 years ago, when it was known as the "material and information flow" and was exploited by Toyota Motor Corporation as a visual mapping procedure to advance a better understanding in the flow material and information through the whole company Manos, (2006). Value stream mapping is a mapping tool for the set of activities (value-added as well as non-value-added) that are essential to bring the product from raw material to the finished product for the customer Rother and Shook (2003) Value stream mapping is one of the cherished tools for understanding the current process status and appreciating opportunities to make improvements (2007). Value stream mapping envisions the process of the entire operation by utilizing flow chart with help from symbols, metrics, and arrows Pai, (2010). Value stream mapping in connection to preceding studies is capable of enhancing the effectiveness of value chain analysis by advancing consumer assessment in the respective phases (Zokaei & Simons, 2006; Dadashnejad and Valmohammadi, 2018). The value stream mapping techniques incorporate: the visualization of complex work flows, evaluation of the resources needed and restructuring of the work flows into a progressed version with accentuation on the patient's needs Jimmerson, (2010).

## **III. METHODOLOGY AND LITERATURE REVIEW**

A wide-ranging literature review was overseen with a paradigm of categorizing a system for value stream mapping studies and developing a research agenda for the future in connection to study population and research design. The papers were transcendentally recovered from operations management journals, although publications were also found (through database searches) in management science, supply chain management and decision science journals, collected primarily from Emerald, Science Direct, Inderscience and Jstor. In conclusion 50 articles were selected and summarized according to the pertinence of the research view.

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The supreme imperative measure of any research project begins with a review of the existing literature (Denyer and Tranfield, 2009; Rousseau *et al.*, 2008; Transfield *et al.*, 2003). A literature review is a logical, clear and reproducible method to examine, measure and comprehend the existing-related discipline (Fink, 1998; Seuring and Muller, 2008; Winter and Knemeyer, 2013).

Table 1: Detailed summary of previous literature review articles

Title	Authors (Year)	Published in	Focus and objective	Number of publication	Type of publi catio n	Methodology	Study population	Sampling Design
1. Application of value stream mapping using simulation to decrease production lead time: A Malaysian manufacturing case	Paranitharan <i>et al.</i> , (2011)	International Journal of Industrial and Systems Engineering	To improve production lead time using VSM as a Technique	28	Paper	Focused on 28 papers by scrutinizing topics by emphasizing current and future state map for back plate indoor	Focused on two product lines	lack information on the sampling design used
2. A VSM improvement-based approach for lean operations in an Indian manufacturing SME	Saboo <i>et al.</i> , (2014)	International Journal of Lean Enterprise Research	Reducing production lead time Reducing in-process and finished goods inventory Reducing process bottlenecks with respect to customer demand.	41	Paper	Highlighting viable application of approaches, such as lean manufacturing, to continually and systematically improve their operations.	Anchored in one department (sheet metal department) with a focus in 3 product lines	lack information on the sampling design used
3. Development of value stream map for an Indian automotive	Vinodh <i>et al.</i> , (2015)	Journal of Engineering, Design and Technology	to apply Value Stream Mapping (VSM) for enabling leanness in an Indian automotive components	20	Paper	Conducted from 20 reputable international journals to	Information flow within three departments	lack information on the sampling design used

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			components manufacturing organization			manufacturing organization		highlight the state of value stream map in automotive components		
4.	Value Stream Mapping using Simulation at Metal Manufacturing Industry	Raja <i>et al.</i> , (2014)	International Conference on Industrial Engineering and Operations Management	The development of current state and proposes future state VSM using simulation with a focus on a manufacturing industry to investigate how dynamic VSM can be adapted in the discrete manufacturing environment.	16	Pape r	methodology applied in this project include: i. Product Selection ii. Data gathering at the various work center iii. Development of Current State Value Stream Map. iv. Development of Simulation Model v. Lean Waste Analysis using Simulation Model vi. Proposing the Future Value Stream Map	Focused on one set of a product line	Lack of information on the sampling design adopted	
5.	Value Stream Mapping and Warehouse Performance among Malaysian Manufacturing Industry	Mohd <i>et al.</i> , (2018)	International Journal of Supply Chain Management	To determine the relationship between VSM and WP among Malaysian manufacturing industry.	28	Pape r	Focused on 28 papers by examined topics, methodology and analytical	2,700	lack information on the sampling design used	

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6.	A cross-sector review on the use of value stream mapping	Wenchi <i>et al.</i> , (2017)	International Journal of Production Research	To determine the-state-of-the-art development of VSM in five sectors, including manufacturing, health care, construction, product development and service sectors.	131	Paper	comprehensive literature review is conducted to visualize complete implementation cycle of VSM	Focused on 131 journal articles from the period of 1999–12/2016	lack information on the sampling design used
7.	A new value stream mapping approach for complex production systems	Marcello and Gionata (2006)	International Journal of Production Research	To determine a framework applied in Value Stream Mapping to products with complex Bill of Materials	13	Paper	Focused on 13 papers by examining value stream mapping procedure	Anchored on seven iterative steps and integrates	lack information on the sampling design used
8.	An Assessment of Significance of Value Stream Mapping to Mitigate Challenges Related to Solid Waste Management: Insights from Literature	Anne and Ngacho (2017)	Mediterranean Journal of Social Sciences	To sensitize all the stakeholders of SWM the strategic methods to reduce and mitigate challenges to SWM as reviewed in literature.	25	Paper	A systematic review of the existing research highlighting the scope of existing research and direction for future research	800	lack information on the sampling design used
9.	Ergonomic Value Stream Mapping: A Novel Approach to Reduce Subjective	Arce <i>et al.</i> , (2018)	Springer International Publishing	To provide academics and practitioners with a novel tool capable to satisfy current needs in manufacturing	39	Paper	focus on fostering both productivity and ergonomic factors at the workplace with view of value stream	eight persons from different hierarchy levels	lack information on the sampling design used

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	Mental Workload			environments, regarding cognitive ergonomics assurance at workplaces.			mapping		
10	The Effectiveness of Value Stream Mapping (VSM) as an Improvement Tool for the Manufacturing Operation	Mohd <i>et al.</i> , (2014)	Advanced Materials Research	To study critical wastes in production line to recommended new design layout based on Lean Manufacturing techniques	7	Paper	Emphasized on identifying waste and to develop VSM to identify current state and future state process.	state mapping	lack information on the sampling design used
11	Evaluation of value stream mapping in manufacturing system redesign manufacturing system redesign	Serrano <i>et al.</i> , (2008)	International Journal of Production Research	To evaluate the real applicability of VSM to redesign disconnected flow lines based on manufacturing environments with a diversity of logistical problems.	84	Paper	Research methodology based on the multiple case study strategy was adopted (Eisenhardt 1989, Yin 1993, 1994).	Target population of 12 companies with the selection of the six definitive cases	lack information on the sampling design used
12	Applying Value Stream Mapping to eliminate waste: a case study of an original equipment manufacturer for the automotive industry	Lacerda <i>et al.</i> , (2016)	International Journal of Production Research	To improve the performance of the production process, through the reduction of wastes and thus increasing its quality and efficiency.	34	Paper	Describes the use of the lean tool value stream mapping in the production process of automotive parts for a major automotive company.	98	lack information on the sampling design used
13	Integrating value stream mapping and discrete events simulation as	Helleno <i>et al.</i> , (2015)	International Journal of Advanced Manufacturing	To apply the value stream mapping (VSM) and discrete events simulation as decision-making tools to	29	Paper	Focused on quality, productivity improvement, and cost reduction tools has	15 subdivisions of the production line	lack information on the sampling design used

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decision making tools in operation management		Technology	direct the management invest in the best option among the available scenarios generated by simulation system.			excelled in industrial environments based on the results achieved by many companies.		
14 Value stream mapping: Literature review and implications for Indian industry	Singh <i>et al.</i> , (20110	International Journal of Advanced Manufacturing Technology	To highlight some of critical issues relevant to value stream mapping.	49	Pape r	Highlighted the role of VSM as a simulation device to quantify the impact of improvement activities.	comprehensive literature review in the context of conceptual frame work 15 journals, empirical/mod el work 11 journals, case studies journals, and survey articles journals was conducted to propose a framework	lack information on the sampling design used
15 Application of lean in construction using value stream mapping	Ramani and Laxmana, (2019)	Engineering Construction & Architectural Management	To discuss the effectiveness of Lean technique in managing construction projects.	19	Pape r	Step-by-step methodology adopted for this research study.	Five stage flow of activities was adopted	lack information on the sampling design used
16 Does Value Stream Mapping affect the structure, process,	Nowak <i>et al.</i> , (2017)	Systematic reviews	To examine the effectiveness of Value Stream Mapping on	68	Pape r	A systematic literature review is carried out.	Of the 903 articles retrieved, 22	lack information on the sampling

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	and outcome quality in care facilities? A systematic review			structure, process, and outcome quality in care facilities.				studies fulfill the inclusion criteria.	design used
17	The Application of Value Stream Mapping Based Lean Production System	Chen and Meng(2010).	International journal of business and management	To establish the effects of value stream mapping adoption	5	Paper	Highlighted the role of VSM based on lean production system for Chinese enterprises to help them deploy lean production systematically.	A skewed literature review in the context of conceptual frame work was adopted	lack information on the sampling design used
18	Value Stream Mapping in Enhancing Operational Performance of Ghanaian Food Processing Industry: Mediating Role of Supply Chain Collaboration	Pokuua-Duahand Nadarajah (2020).	International Journal of Business and Social Science	To assess effect of VSM on operational performance (waste reduction and elimination, product quality), the mediating role of supply chain collaboration (SCC).	104	Paper	Highlighted the direct and indirect effects of VSM on operational performance through the influence of supply chain collaboration in the food processing industry context.	comprehensive review literature of 104 journals was conducted to propose a framework	lack information on the sampling design used
19	Applying Value Stream Mapping to Identify and Evaluate Waste in a Company of the Ceramic Sector	Luna <i>et al.</i> , (2013)	Advances in Sustainable and Competitive Manufacturing Systems	To use Value Stream Mapping (VSM) to identify waste within a company in the red ceramic sector.	13	Paper	Focused on the following steps of Selection of the family of products , Mapping the current state, Mapping the future state and Mapping the future state proposed by Rother and Shook	production system was under consideration	lack information on the sampling design used



						(1999)			
20	UTILIZATION OF VALUE STREAM ANALYSIS TO IMPLEMENT REDEFINED VALUE: A SOCIAL BUSINESS PERSPECTIVE	Bahar <i>et al.</i> , (2015)	Social business perspective. Review of Business & Finance Studies	To redefined CSE value in a social business through the utilization of the value stream analysis tool.	94	Paper	Strives to redefine the conceptualization of value in the milieu of social business.	Ten phases of the Business Process were reviewed	lack information on the sampling design used
21	Application of Value Stream Mapping to Improve Financial Performance of a Production Floor: a Case Study	Talapatra, and Shefa, (2019)	the International Conference on Industrial Engineering and Operations Management Bangkok	To initiate the adaptation of Lean in a furniture industry by the application of value stream mapping	26	Paper	Highlighted the following VSM steps: Selection of Target product Family, Data Collection, Preparation of the current state map, Data analysis of the current state map, Suggested Improvement in future state map, Preparation of future state map and Analysis of rusts	Concentrated on a Production metrics of 4 activities	lack information on the sampling design used
22	Value Stream Mapping using Simulation at Metal Manufacturing Industry	Rasi <i>et al.</i> , (2014)	International Conference on Industrial Engineering and Operations Management	To investigate how simulation can be used to compliment VSM tool	16	Paper	Highlighted the complimentary use of VSM and simulation using the following steps: Product Selection, Data gathering at the	Concentrated on a Production metrics of 8 activities of 8 products	lack information on the sampling design used

							various work center, Development of Current State Value Stream Map (CVSM), Development of Simulation Mode, Lean Waste Analysis using Simulation Mode and Proposing the Future Value Stream Map (FVSM).		
23	Application of Value Stream Mapping In An Indian Brass Lamp Manufacturing Organization	Paranitharan <i>et al.</i> , (2015)	International Journal of Applied Engineering Research	To minimize the non-value added activity and revamp the existing system of brass lamp manufacturing Company by implementation of lean concept using seven step approaches.	10	Paper	Formulated a seven steps methodology to improve the process ratio of manufacturing process.	Concentrated on an 8 step operations and its components	lack information on the sampling design used
24	SIMULATION OF PRODUCTION PROCESS REORGANIZED WITH VALUE STREAM MAPPING	Gjeldum <i>et al.</i> , (2011)	Tehnicki vjesnik	To present application of simulation on production process previously analyzed with Value stream mapping tool.	9	Paper	Focused on application of Lean management tools, development of their future improvement and simulation.	one production process in one Croatian shipbuilding factory is used	lack information on the sampling design used
25	Value Stream Mapping and Process Optimization Strategy: A Case Study of Public Sector	Javed <i>et al.</i> , (2013).	Concurrent Engineering Approaches for Sustainable Product Development in a Multi-	To trace out the impurities in the functioning of the public sector organization process by applying valuable tools and thus take appropriate measures to get rid of them.			Focused on manual process functioning analysis and post SAP (Systems Applications and Products)	Four public sector departments Working at District Level were under study	lack information on the sampling design used

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Organization		Disciplinary Environment					installation analysis.		
26	Using value-stream maps to improve leadership	Emiliani and Stec (2004)	Leadership and Organization Development Journal.	To establish the use of value-stream maps for determining the beliefs, behaviors, and competencies possessed by business leaders.	44	Paper	Highlighted the current- and future-state value-stream maps for manufacturing and service business processes in relation to the progression from belief to behavior to competency	Focused on the current- and future-state value-stream maps for manufacturing and service business processes	lack information on the sampling design used
27	A literature review of lean manufacturing	Shaman and Sanjiv (2013)	International Journal of Management Science and Engineering Management	To understand the concept of lean manufacturing, its philosophy, various tools and techniques, lean implementation benefits and barrier towards lean implementation.	71	Paper	presents a review of the literature and attempts to identify the important and useful contributions to VSM	about 120 papers for the search combining 'lean Implementation' and 'lean surveys', about 83 for 'lean concept' and approximately 48 papers for 'lean and challenges'.	lack information on the sampling design used
28	Utilizing Simulation to Enhance Value Stream	McDonald <i>et al.</i> , (2002)	International Journal of Logistics	To investigate the main difficulties and limitations encountered during the construction of current state maps, analysis of the	18	Paper	Focuses the application of value stream mapping in an actual setting and the use of simulation to	Anchored on one product line with the view of VSM	lack information on the sampling design used

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	Mapping: A Manufacturing Case Application			associated causes, and pointing out of guidelines to facilitate the use of VSM to map processes.			answer questions that could not be addressed only using the static view provided by value steam mapping.		
29	VALUE STREAM MAP AND KAIZEN CONCEPT IMPLEMENTED IN A SHAFT MANUFACTURING CHAIN	Buruiană <i>et al.</i> , (2009)	The Annals of” Dunarea de Jos” University of Galati, Fascicle V, Technologies in machine building	To determine if future state map is based on the continuous improvement process.	26	Paper	focused on the analysis and use of the VSM to get improvements by means of kanban	Focused on shaft manufacturing chain	lack information on the sampling design used
30	IMPROVING PROCESS OF QUOTATION CREATION THROUGH VALUE STREAM MAPPING AND SIMULATION	Sremcevic <i>et al.</i> , (2019)	International Journal of Simulation Modelling	to improve the company's business through the application of the product configurator	30	Paper	Focused on application of VSM in processes of products configuration and products quotation creation.	Anchored on two product lines: simple product line and complex product line	lack of information on the sampling design used
31	Application of Value Stream Mapping for Reduction of Cycle Time in a Machining Process	Venkataraman <i>et al.</i> , (2014)	Procedia Materials Science	To explain the implementation of lean manufacturing techniques in the crankshaft manufacturing system at an automotive manufacturing plant located in south India.	20	Paper	Focused on the preparation of future state value stream map from the current state value stream map, tools and techniques of Lean Production System were used to establish the single	Anchored on one product line	lack of information on the sampling design used

							piece flow in the line, by implementing kaizen.		
32	A LITERATURE REVIEW ON VALUE STREAM MAPPING WITH A CASE STUDY OF APPLYING VALUE STREAM MAPPING ON RESEARCH PROCESS	Li <i>et al.</i> , (2014)	Texas A&M University Libraries	To administer an in-depth literature review on value stream mapping, especially concerning useful value stream mapping tools and the application of value stream mapping in construction industry.	19	Thesis	Focused on the value stream mapping tool and its application. In order to build the theoretical framework, a comprehensive literature review is important for the first part of this study.	Anchored in 19 peer reviewed journals	lack of information on the sampling design used
33	VALUE STREAM MAPPING IN LEAN PRODUCTION AND AN APPLICATION IN THE TEXTILE SECTOR	İnce <i>et al.</i> , (2018)	Journal of International Trade, Logistics and Law	To establish the success achieved by applying one value stream mapping at a textile manufacturing company and to contribute to the literature	33	Paper	Focused in Value Stream Mapping in Lean Production and its application in the Textile Sector	Anchored in a Process matrix and product family selection for product family selection of 15 items	lack of information on the sampling design used
34	Waste identification diagram and value stream mapping A comparative analysis	Dinis-Carvalho <i>et al.</i> , (2019)	International Journal of Lean Six Sigma	To compare the well-known value stream mapping (VSM) with a recent tool named waste identification diagram (WID), regarding the capacity of information representation and easiness of interpretation.	34	Paper	Focused on VSM and waste identification diagram, in terms of ability to identify several types of waste	involved three types of stakeholders: researcher, Industrial Engineering students and IE professionals	lack of information on the sampling design used
35	Value Stream	Schoeman	Sustainability	To demonstrate the	46	Paper	Highlighted the	Was anchored	lack of

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	Mapping as a Supporting Management Tool to Identify the Flow of Industrial Waste: A Case Study	<i>et al.</i> , (2021)		application of VSM as a supporting management tool to identify and evaluate industrial waste flow in the iron and steel industry at a Southern Africa case study.		r	implementation of VSM method with a view of cost savings and reduction of waste flow.	in identification, demonstration, and evaluation of industrial waste comprising of three steps.	information on the sampling design used
36	Sustainable-value stream mapping to evaluate sustainability performance: case study in an Indonesian furniture company	Hartini <i>et al.</i> , (2019)	MATEC Web of Conferences	to propose a four-step approach for measuring the environmental performance of supply chains in the food sector based on lean thinking techniques so as to identify sources of waste in the selected supply chain	30	Pape r	Examined the economics of a manufacturing line, most of which are in regards to time.	10 companies furniture were under review of their design metrics in sustainable-VSM	lack of information on the sampling design used
37	Function of Value Stream Mapping in Operations Management Journals	Fukuzawa, (2020)	Annals of Business Administrative Science	To identify and resolve bottlenecks in individual functions and divisions, primarily in production activities.	92	Pape r	Focused on VSM as a lean tool to improve the workplace such as production units	comprehensive review literature of 92 journals was conducted based on the function of VSM in operations management	lack of information on the sampling design used
38	Integration of value stream mapping and agent-based modeling for OR	Xie and Peng (2012)	Business Process Management Journal	to reduce the patient time of stay in the hospital	32	Pape r	Focused on VSM in relation to OR process and activity for the further what-if analysis and	Reviewed the flow chart of the capacity and schedule planning.	lack of information on the sampling design used

	improvement						simulation to assess the OR performance and improvement.		
35	Application of value stream mapping in an Indian camshaft manufacturing organization.	Vinodh <i>et al.</i> , (2010)	Journal of Manufacturing Technology Management	To apply value stream mapping (VSM) for enabling leanness in an Indian camshaft manufacturing organization.	33	Paper	Based on literature review on lean manufacturing and VSM & Derivation of inferences based on the conduct of case study	Anchored in product selection, current state map and future state map	lack of information on the sampling design used
40	Evaluation of value stream mapping (VSM) applicability to the oil and gas chain processes.	Vasconcelos <i>et al.</i> , (2018)	International Journal of Lean Six Sigma	To verify the applicability of the VSM tool to oil and gas chain processes	138	Paper	Involved a four-step process (identification, screening, eligibility and inclusion) suggested by Moher <i>et al.</i> (2009)	Systematic review of the literature in the Scopus database, analyzing data from 2012 to 2017	lack of information on the sampling design used
41	Developments of traditional value stream mapping to enhance personal and organizational system and methods competencies	Sunk <i>et al.</i> , (2017)	International Journal of Production Research	To extend the view on value streams of both researchers and practitioners in sense of system and methods competencies	74	Paper	focused on shifts in improvement paradigms respectively in production improvement priorities	System Competencies and Method Competencies in findings of specific VSM publications was adopted	lack of information on the sampling design used
42	A Systematic Literature Review for Better Understanding of Lean Driven Sustainability	Tasdemir and Gazn(2018)	. sustainability	To investigate the findings of past literature reviews in detail	341	Paper	To identify and evaluate relevant previous literature addressing inter-relationships among the three research	A systematic literature review of 341 papers was conducted	lack of information on the sampling design used

						streams			
43	Improvement of Value Stream Mapping and Internal Logistics through Digitalization: A study in the context of Industry 4.0	Sultan and Khodaband. (2020).	Malardalen University repository	To investigate the improvement potentials of digitalization for the value stream mapping and the internal logistics of the production system.	162	Thesis	Focused on identification of challenges VSM and internal logistics system and possible improvement opportunities.	12 operators and 7 managers/engineers	lack of information on the sampling design used
44	Application of value stream mapping (VSM) for lean and cycle time reduction in complex production environments: a case study	Seth <i>et al.</i> , (2017)	Production Planning & Control	To illustrate, how with some approximations and rearrangement VSM application, lean can be effectively accomplished in these environments.	69	Paper	Systematically guides about the segregation and treatment of non-value-adding (NVA) and value-adding (VA) activities of heavy-duty industrial power transformer making process.	one production manager, two production engineers, one senior design engineer, head materials handling, testing in-charge, materials manager, planning engineer and one industrial engineer	lack of information on the sampling design used
45	A new value stream mapping approach for engineer-to-order production systems. In IFIP	Thomassen <i>et al.</i> , (2015)	International Conference on Advances in Production Management Systems	To create a new value stream mapping approach for the design of flow oriented ETO production systems.	20	Paper	Focused on the design of lean production control systems in ETO environments.	A review of relevant literature(20 journals) in the lean manufacturing	lack of information on the sampling design used



								field was carried	
46	Approach to Value Stream Mapping for Make-To-Order Manufacturing	Mudgal <i>et al</i> (2020)	53rd CIRP Conference on Manufacturing Systems	To use a case study based approach and demonstrate a methodology to use VSM for a MTO and intend to highlight some distinctiveness of the MTO environment	24	Paper	Focused on development of the current state and future state value stream map.	Anchored in one product line	lack of information on the sampling design used
47	Requirements for a Value Stream Mapping in Make-To-Order Environments	Koch and Lödging (2014)	International Conference on Advances in Production Management Systems.	To describe the shortcomings of VSM with respect to an application in a MTO production.	12	Paper	Focused on discrepancy between the conventional VSM and a MTO production	Anchored on a manufacturing control model	lack of information on the sampling design used
48	Value stream analysis of a re-engineered construction supply chain	Arbulu <i>et al.</i> , (2003)	Building Research and Information	To establish clearly defined process protocols and have all involved work together towards a shared set of objectives.	34	Paper	Focused on introducing value stream mapping as a methodology for modelling and analyzing supply chains.	25 practitioners	lack of information on the sampling design used
49	Applying Value Stream Mapping in Manufacturing: A Systematic Literature Review	Romero and Arce (2017)	IFAC-Papers On Line	To establish if implementation of lean approach depends on Value Stream Mapping	141	Paper	Focused on a systematic review which followed applicable guidelines set in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement.	A systematic literature review of 341 papers was conducted	lack of information on the sampling design used
50	Value Stream	Forno <i>et</i>	International	To identify the main	Paper	85	Focused on	A systematic	lack of

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Mapping: a study about the problems and challenges found in the literature from the past 15 years about application of Lean tools.	<i>al.</i> , 2014	Journal of Advanced Manufacturing Technology	difficulties and limitations in VSM current state map construction, its major causes, and the guidelines for its use.	classification of the papers either theoretical or practical in the application of VSM	literature review of 341 papers was conducted	information on the sampling design used
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#### **IV. RESEARCH GAP**

Basic gaps acknowledged:

- The focus of most articles was on the survey and case study, whereas conceptual model, mathematical model, interviews, empirical triangulation (mixed methods) and simulation were used in a limited number of published articles.
- Empirical triangulation was conducted in 50 articles of the 84 reviewed. This illustrates that blended methods were not used effectively, and future studies ought to consider utilizing empirical triangulation methods.
- Despite the high number of studies that were conducted in value stream mapping, the present literature reviews show the lack of in-depth research in value stream mapping and missing link in relation to study population and sampling design application.
- Most of the published articles in value stream mapping were derived from developed countries whereas more research is necessitated in developing countries.
- Further analysis of publications between 2017 and 2020 is recommended as to causality.
- Finally, value stream mapping research is needed to establish the relationships between places where an organization should improve on its operations by visualizing both its value-adding and wasteful steps and its impact on ROI and organizational performance.

#### **V. CONCLUSION**

The sample design and study population are critical components in any scholarly work be it case study or literature review based. Besides that the study design is the use of evidence-based procedures, protocols, and guidelines that provide the tools and framework for conducting a research study hence making it a very critical component of any scholarly writing. And sample design addresses intended purpose and procedure to be adopted in selecting sample from the target population and the statistical estimation formula for computing the sample statistics. Hence compiling all scholarly studies to adopt an appropriate and reliable sample design in order to yield genuine random sample as a result avoiding biased result.

#### **VI. FUTURE RESEARCH**

This research has elaborated the state-of-the-art and current position of value stream mapping from diverse perspectives. Implications from this research indicate the following themes for future research trends in the discipline area:

- This paper presented a study focusing on the present status of value stream mapping by concentrating on research methods, different data sources, methodology, study population and sample design. However, the current literature review is limited to reviewing only published articles from Emerald, Science Direct, Taylor and Francis, Wiley, JSTOR and Springer. Additional focus on value stream mapping respect to numerous other well-known journals, and books for future research is necessary.
- This review can be extended and embellished by including conferences, doctoral and master thesis and other databases. Additionally, this research is limited to those published articles which contain the word “value stream mapping in their title and/or abstract.
- By conducting a more comparative investigation between regions and countries, especially between developed and developing countries, in the context of market globalization, value stream mapping and sustainable company practices support the need for focused future research.

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