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A Systematic Literature Review of Lean Six Sigma in Various Industries

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Abstract *The Lean Six Sigma / LSS approach has received a lot of attention in various industrial sectors, from the manufacturing industry to the service industry. More specific knowledge about Lean Six Sigma has increased. Much of the training and research on Lean Six Sigma is carried out in various sectors. This literature review is related to LSS's purpose to provide an overview of Lean Six Sigma implementation in the manufacturing industry. The Lean Six Sigma approach introduced and implemented for a long time is DMAIC (Define, Measure, Analyze, Improve, and control). This paper discusses the published literature related to Six Sigma ranging from 2015 to 2020. This paper involves the study review of 50 articles related to the implementation of LSS of general database search, including Google Scholar, Elsevier, Science Direct, and other worldwide publishers. This literature review contains results from a variety of different perspectives. The perspective includes the industry's focus, the focus of the number of distribution by country, the year of publication, and the number of publishers. This is useful for all types of manufacturing industries to find solutions to problems. The paper also provides advantages for researchers next to add to the literature.*

Keywords*: lean Six Sigma, quality improvement, DMAIC, industries*

1. Introduction

In the competition in the global market, a business strategy is needed to win the match. The business strategy for achieving a competitive advantage is the successful implementation of a quality management system. Lean Six Sigma is here as a tool to make it happen. Lean Six Sigma is one of the most popular initiatives in industry sectors, including industrial manufacturing. Lean Six Sigma has developed rapidly in various industries. The Six Sigma approach is used as a tool s in solving the problem of production that can be formulated breakthrough in the increase of production, reduce disability products, reduce the cost of production, reducing the time cycle of production, increase growth in the share of the market, to the retention of customers. The Six Sigma method is needed by companies, especially the production department, to improve their production quality. Especially in technology, the products' power competitiveness is rigorous and demanding speed is high. Generally, Six Sigma implementation is carried out in the manufacturing industry to reduce variability in processes to provide a better organization, product, or service to customers and minimize error. According to [1](Winters-Miner et al., 2015), the chapter book about Six Sigma aims to achieve quality by reducing variation in processes. Six Sigma seeks to reduce error rates such that six standard deviations around the mean of a process fit between the upper and lower tolerances. For example, a manufacturer producing lock barrels had to make sure the barrels' diameters were proper. If they were too large, they wouldn't fit the lock's assembly, and if they were too small, they also wouldn't provide. Ideally, the upper and lower control limits include six standard deviations on each side of the mean to result in no more than 3.4 bad parts in 1,000,000 opportunities for error (99.9997% accuracy).

According to [2](Wang et al., 2016), numerous companies have embraced Six Sigma projects for improving their competitiveness over the past three decades. Six Sigma is a structured approach to problem-solving that entails

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emphasizing improving or optimizing existing products or processes.

According to [3](Pereira et al., 2019), Six Sigma is accepted in companies for quality improvement. If it is used just as a statistical tool to solve complex problems, then it won't be successful because Six Sigma sets the target that needs to be achieved. In this context, Lean Six Sigma uses a scientific method like DMAIC and DMADV to solve problems. And then, according to [4](Vincent Gaspersz, 2002), two six sigma methodologies can be used, namely: DMAIC and DMADV. DMAIC is used to improve the business processes that exist, whereas DMADV is used to create the new design process and or design of the product fresh in the way of such a form to produce a performance free of guilt (zero defect/error). This paper discusses the six sigma strategy with the DMAIC stages. There is five stages or steps basis in implementing Six Sigma's approach: the Define-Measure-Analyze-Improve-Control (DMAIC), where the stage is a stage that is repetitive or forming cycle of improvement of quality with Six Sigma. The following is an explanation of each phase: (1) Define: A stage of beginning the focus to identifying problems, determining the purpose of the process, and identifying customers' needs are internally and externally through Pareto Chart Critical To Quality. (2) Measure: Stages measure it objectively establishes the foundation of improvement is a step of collecting the data with the purpose to develop a standard of performance through Pareto Chart, measurement of process capability (Level sigma or process sigma), as well as the Four Block Diagram. (3) Analysis: Phase Analysis isolate the cause of a major that is focused on by the team. The analysis's implementation is a hydraulic diagram fishbone and test hypotheses (Hypothesis test of a vital factor). (4) Improve: Stage improvement focuses on understanding fully the cause of a major who is identified in phase analysis, in phases improve among others, namely design of experiments, measurement of process capability after improvement (Level sigma-sigma process). (5) Control: Stage set standardization, control, and maintain the process has been improved and enhanced in term length to prevent potential problems that will occur or when there is a change of operations, personnel work, and evolution of management of Statistical Process Control (SPC). DMAIC is used when a company already has a product finished or products that are still in the process stage but have not reached the customer's specifications.

2. Methods

This paper's purpose of exploring more deeply the implementation of Six Sigma in various industries. Learn to search and find several journals starting from the nearest year until 2015 in all international publications. Studies carried out by men notice database famed, including Google Scholar, Elsevier, Science Direct, and other publishers. This paper's purpose of elaborating on knowledge about the value of Six Sigma in the industry, consider Six Sigma as an organizational strategy, and search for ways to get more insight into six Sigma.

In doing a literature review, several steps must be executed so that the systematic and directed implementation. The first step is to formulate the problem. In this stage, the writer is required to choose a topic that matches the issue taken. Questions must be written entirely and accurately. Then the second step is looking for literature and journals. At this stage, the writer looks for literature relevant to the research and then looks for an overview of the research topic. After that, review according to case based on research sources.

The third step is to evaluate or identify the literature. Search results are sorted as case studies or industry focus theory, focus number of distribution by country, focus year of publication, and publishers' number. The data collected, analyzed, and the results are presented in graphical form. At this stage, look for the similarities and inequalities of the literature obtained. Then compare from various perspectives, then make a summary (summarize). The fourth step concludes the identification of all the literature obtained. The last stage is publishing in national and international journals. More details can be seen in Figure 1.

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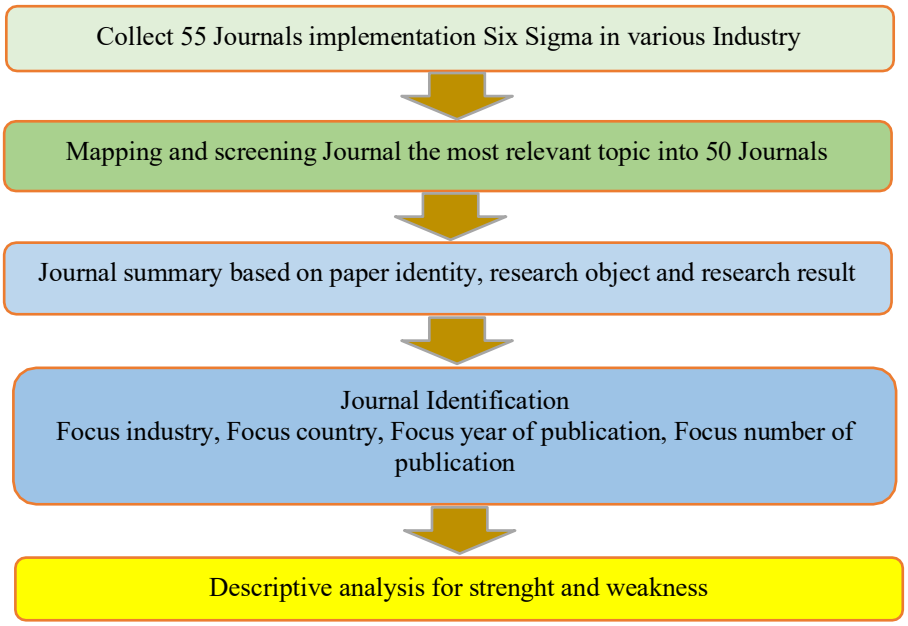

Fig 1. Study Framework

3. Results and Discussion

3.1. Journal Summary

This paper identifies 50 journals related to the implementation of Six Sigma in the manufacturing industry. The selected journals or articles will be analyzed. The analysis was carried out based on the researcher and year, research object, and research results. The author summarizes them in Table 1.

Table 1. Existing Literature review of Lean Six Sigma in Various Industries

No	Paper Identity	Research Object	Result
1	(Kurniawan & Prestianto, 2020)[5]	Minimize defective product on baby clothes	Sigma value of 4.14, meaning a possible defect product of 4033.39 opportunities per million products
2	(Haryanto & Ichtiarto, 2020) [6]	Defect reduction in automotive	Dirty defects are the most significant defect type of 20.92%, temperature and conveyor speed factors, and environmental factors
3	(Kaswan & Rathi, 2020) [7]	The sustainable oriented demand	The framework provides a path for GLS implementation through an appropriate selection of the project
4	(L. B. M. Costa et al., 2020) [8]	To examine how the food industry sector's characteristics affect	The Six Sigma role structure and Statistical Process Control practices were among the least adopted methods in the Sector
5	(Niñerola et al., 2020) [9]	To improve patient quality and safety	Can emphasize the operating room and radiology service, the objectives are focused mainly on achieving reductions of time, costs, and errors, to quality improvement and the patient's satisfaction
6	(Reaz et al., 2020) [10]	Reducing such waste can be profitable options for the	This shows that the defective rate dropped from 4.13 to 1.25 of a line daily production.

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No	Paper Identity	Research Object	Result
		manufacturers	
7	(Huda, 2020) [11]	Quality control welding construction	The sigma level is in the 3.21 sigma position with a DPMO value of 43,958.93
8	(Fithri, 2019) [12]	Quality control of the textile industry fabrics	The Defect per Million Opportunity value obtained was 181.67, and the Sigma value was 5.07
9	(Aina Nindiani et al., 2019) [13]	Defect reduction in automotive	Butsu and hijiki defects were dominant, the DPMO (Defects per Million Opportunities) value was 31.91%, and the sigma value increased from 2.90 to 3.10.
10	(Erdil, 2019) [14]	The development of quality management in the textiles industry	Assessed on the framework of quality, robust and environment-oriented production such as green production
11	(Lajoie et al., 2019) [15]	To resolve potential issues related to the variable process	Three steps in a framework which includes the definition and the characterization in the industrial process, predictive modelling, and prescriptive analytics
12	(Pereira et al., 2019) [3]	Analyze the Key Performance Indicator (KPI)	The CS indicator for the year 2017 was relatively low, especially in gate 3. Part Per Million is lower because there are fewer complaints, and then there would also be fewer rejected parts.
13	(Gaur, 2019) [16]	Improves the OR efficiency and reduces the cancellation	That by improving list management, OR rescheduling, reducing patient pathway time, reinforcing Day Care Surgery Program
14	(Goyal et al., 2019) [17]	Quality control at the production process	Evidence of achieving higher sustainability for competitiveness by classifying defects based on their end impact
15	(J. P. Costa et al., 2019) [18]	Reduce the defective units produced by an automatic process	Reduction in the number of defective units from 3231 ppm to 312 ppm and the increase in the sigma level from 4.22 to 4.92
16	(Nørup et al., 2019) [19]	It improved reuse and recycling.	The clothing and household textiles in residual waste is 12 ± 5.3% and 15 ± 10.5%, and the dress and household textiles in small combustibles is 14 ± 3.9% and 16 ± 8.7%
17	(Neutze & Stortz, 2018) [20]	Applicability in health care	Performance-based to value-based payment models, health-care providers will need to become adept with quality improvement skills.
18	(Söylemez & Tarhan, 2018) [21]	Product quality improvement	The suggestion method was efficient in the effort to be required and effective in development performance and product quality improvement
19	(Wu et al., 2018) [22]	Wire Arc Additive Manufacturing (WAAM) process	The wide application of WAAM still presents many challenges, and these may need to be addressed in specific ways for different materials to achieve the operational system in an acceptable time frame
20	(Roesmasari et al.,	Quality improvement	Open grain with a value of 576 and the second

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No	Paper Identity	Research Object	Result
	2018) [23]	in leather garment	highest RPN value of 448 for fish eye defects. The type of cracking defect also has an RPN value of 448
21	(Nasution & Sodikin, 2018) [24]	Quality improvement in carton box	Mould defects were 109,439 units (49.2%) of the total defects, namely 222,421 units
22	(Didiharyono et al., 2018) [25]	Quality improvement in drinking water	The average sigma level is 1.929, or 33.5% Defect Per Million Opportunities (DPMO). Factory Reject with a percentage of the total damage is 57.1% and Reject Supplier as much as 42.9%
23	(Elza & Santosa, 2017) [26]	Reduce defect in the garment industry	Off-centre oblique stitches' defects on day 1 were 61.8%, with 21 defects out of 34 defects and 55.0% with 22 defects out of 40 observed B-Grade defects.
24	(Rimantho & Mariani, 2017) [27]	Quality control of water production	After improving the sigma value to 4.09 with a possible failure of the process of 5526
25	(Supriyadi et al., 2017) [28]	Reducing Flexo Machine production defects	Capability and sigma value of company performance in improving product quality is 7560 DPMO with a sigma value of 3.93
26	(Ekawati & Rachman, 2017) [29]	Reducing defects in product horn	The DPMO value was obtained at 86.03, and the sigma value of 5.28
27	(T. Costa et al., 2017) [30]	Improving the rubber extrusion process of two tire semi-products	The study thus culminated in a decrease of 0,89% on the indicator of work-off generated by the production system
28	(Bakar et al., 2017) [31]	Increase fabric productivity	Input from the average index value of productivity, materials (98.85%), and energy (95.11%)
29	(Sihombing & Sumartini, 2017) [32]	Defective product quantity in textiles	Controlling the quality of raw materials and controlling the quality of the process hurts the number of defective products as well as on the cost of quality (Cost of Quality), while the quantity of faulty products has a positive effect on the cost of quality
30	(Nurprihatin et al., 2017) [33]	Reduction of waste in the garment	The values of Defect Per Million Opportunities (DPMO) and Sigma are 2150 and 4.36 sigma
31	(Adikorley et al., 2017) [34]	To explore Lean Six Sigma (LSS) project and program success in the textile and apparel industry	The reduction in the increased sigma level to 3.74. Contamination was reduced on the third line resulting in a 4.32 sigma level
32	(Widiyawati & Assyahlafi, 2017) [35]	Quality control in the Cigarette company	The value of DPMO = 18.92, so it can be seen that the sigma value is 5.62 and the defect type of opp peeling is 20.7%
33	(Pratiwi et al., 2016) [36]	Increase quality grey fabrics	The DPMO value is 20.028 and is at the 3.57 sigma level. While the cumulative sum is known that 579 out of control data from 888 all data
34	(Jardini et al., 2016) [37]	Additive Manufacture technologies applied to design	A series of computed tomography data were obtained, and software was used to extract the cranial geometry

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No	Paper Identity	Research Object	Result
35	(Nakamura et al., 2016) [38]	Two-dimensional photonic crystal nanocavities	Design three-missing-air-hole and zero-cell-defect nanocavities with Q factors of 5,000,000 and 1,700,000, respectively, for demonstration
36	(Danny Darmawan & Ekawati, 2016) [39]	Improved exhaust production	DPMO and sigma values of 12,879 and 3.73 sigma indicate that improvements still need to be made to the exhaust production process
37	(Pugna et al., 2016) [40]	Quality Improvement in the automotive industry	DPMO was reduced from 81 to 108, improved the riveting process led to a 40% defect reduction, for choosing the most suitable Supplier to 30% defect reduction
38	(Eleftheriadis & Myklebust, 2016) [41]	Quality improvements to reach in aerospace	Combination of quality methods as a contribution to rework of products, less waste of material and Improved productivity
39	(F. Hutami & Yunitasari, 2016) [42]	Quality control in the printing	Sigma level 3.78 and priority improvement of work procedures in a company environment that is not going well
40	(Wang et al., 2016) [2]	Developing a new product called very-high-bit-rate digital subscriber line 2 comprising multiple-dwelling units	The profit of this 4-year study is projected at US$6,555,262. Seven patients are invented during this product development.
41	(Wardana et al., 2015) [43]	Quality improvement in garment	Sigma value after corrective action implementation 3,31σ
42	(Prasetyo, 2015) [44]	Quality improvement in an aerosol can	DPMO amount is 22.749,787 with sigma value 3,50. And Weld Problem as the largest number of rejects is 311.226 pcs or 37,91% from all defect
43	(Harpensa et al., 2015) [45]	Quality improvement in the tile industry	DPMO reduce to be 14791, 667 dan sigma value increase to be 3,680
44	(Salomon et al., 2015) [46]	Quality improvement in the plastic industry	Sigma value amount is 4,28 and 1,61% defect to big container 211 PLY, so sigma value amount is 4,40 and 1,09% defect to big container 1L AS
45	(Indrawati & Ridwansyah, 2015) [47]	To improve the process capability in the iron ores industry	The level of Sigma is 2,97. There are 33,67% non-value-added activity and 14,2% necessary non-value-added activity that occurs during the manufacturing process
46	(Alkatiri et al., 2015) [48]	Reduce loss product grey fabric textiles	Value Sigma is 4,09 with average result DPMO are reducing the amount is 1.769,47 (27,13%) and sigma value result increase 0,11 sigma (2,76%)
47	(Rahmiyati & Rahim, 2015) [49]	Increasing productivity	The leading causes of temperature and conveyor speed and environmental factors
48	(Wisnubroto, 2015) [50]	Quality control in the production process	Sigma value is 4,055with DPMO 5.310 and less strict product quality control
49	(Boon Sin et al., 2015) [51]	Developed by integrating organizational	Organizational knowledge creation processes positively affect knowledge

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No	Paper Identity	Research Object	Result
50	(Jevgeni SEduard SRoman Z, 2015) [52]	Measure failures of production processes	Can apply corrective actions and perform continuous improvement by performing daily monitoring of production processes

3.2. Journal Identification

The identification of literature will be identified from various perspectives. The perspective includes the industry's focus, the focus of the number of distribution by country, the year of publication, and the number of publishers. Six Sigma Implementation is very popularly used in the manufacturing industry. More precisely, in the automotive industry.

Figure 2 informed that Six Sigma is more widely implemented in industrial automotive (16%) and garment (16%). This is in line with the growing trend of both industries. In automotive manufacturing companies and garment industries, Six Sigma is used to improve the quality of production. The Six Sigma strategy aims to reduce cycle times and increase customer satisfaction in determining the optimal level and cost of service quality. More details can be seen in Figure 2.

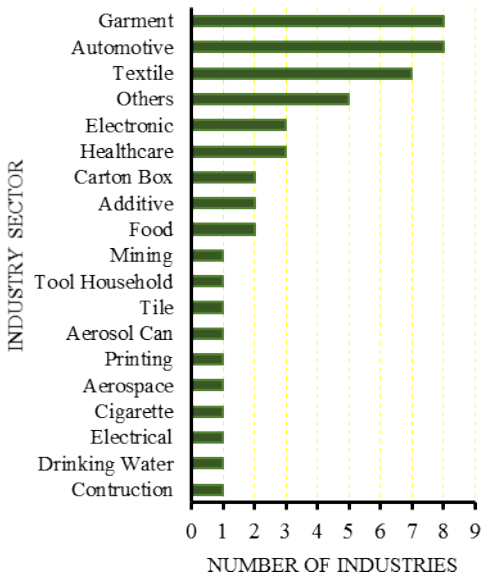

Fig. 2 The Focus of the Industry Sector

Figure 3 analyzes the distribution of Six Sigma publications in manufacturing companies. Indonesia is the most frequently implemented Six Sigma. In this case, Six Sigma neglects, especially in developed and developing countries. Growth in Indonesia is in the figure of 54% from the total publisher, which of the literature review, the projected increase in the economy's complexity. Reports have indicated that Indonesia has many opportunities that have not been utilized in various industries and encourage growth and fieldwork creation. With the development of the economy and the progress of Indonesia's scientific knowledge that sustained, the country is rated to be in the path of the right to be a state of the most powerful in the world. Six Sigma is present in manufacturing enterprises' implementation, remarkably to reduce the variability in the process to give the organization, product, or service that is good to customers and reduce errors. More details can be seen in Figure 3.

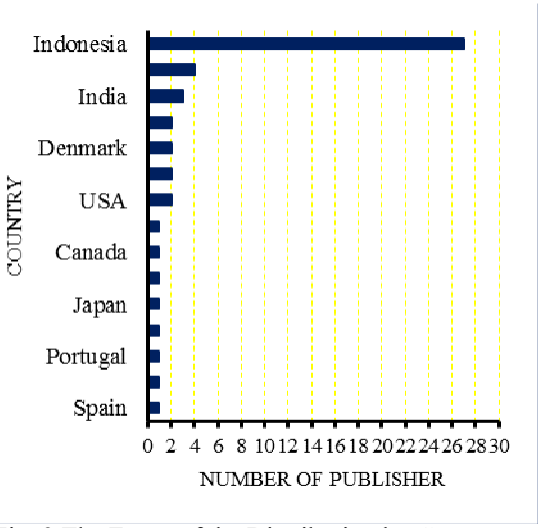

Fig. 3 The Focus of the Distribution by Country

Figure 4 shows that Scholar Publisher was most frequently searched during the 2015-2020 period, 55% (Figure 5). This is evident in identifying the journal, at the most base on publisher Google Scholar. The author suggests that researchers use Google Scholar to collect

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reference sources in research because Google Scholar is also a reputable journal publisher and quickly gets the desired paper research. More details can be seen in Figure 4.

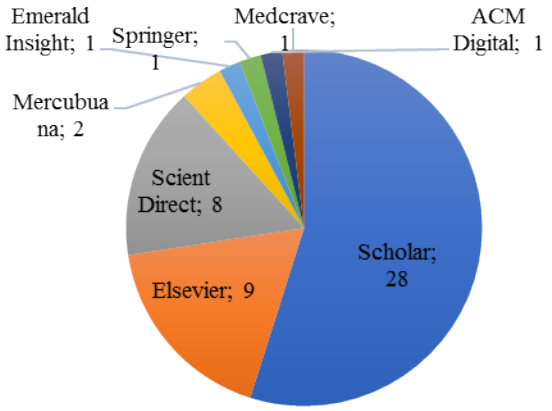

Fig. 4 The Focus of the Publisher

Figure 5 shows that 2015 is a year of publication that was most frequently searched during the 2015-2020 period amount is 11 articles (Figure 5). This is evident in identifying the journal; for several years, almost every year, many journals have entered international publications. More details can be seen in Figure 5.

Fig. 5 The Focus of the Year Publication

3.3. Strength Analysis

In this literature study, the authors found the strength of all the journals that had been analyzed. Power is based on three perspectives, namely journal writing, industry, and science. Journal explained in a clear and complete ranging from the abstract, introduction, review literature, methodology, results & discussion, and conclusions. The advantage for the perpetrator of business is to apply Lean Six Sigma to get the slim, reduce the time of the cycle, my alias excellent, and minimum cost. However, they provided new references for the subsequent researchers in problem-solving related to implementation with the lean six sigma approach.

3.4. Weakness Analysis

In addition to the literature study's strengths, the author also found several weaknesses based on journal writing, industry, and science. The format of writing journals is not organized, so that makes the writer difficulty in identifying literature. The approach of Six Sigma requires a time that is very long in the implementation. Need stages which systematic to get a result that is best and necessary monitoring it regularly. There are many new tools in modern life so that researchers have many options in solving problems. As a result, the Six Sigma approach is neglected.

3.5. Gap in Literature Review on LSS and Future Research Agenda

The authors have identified the following gaps in the current literature on Lean Six Sigma. This gap has been grouped and prioritized as follows. Lack of differentiation between leadership style required from Senior/Executive management and Middle management in organizations. Leadership is a critical factor in the success of Lean Six Sigma. Its impact will be the subject of future research to determine which leadership characteristics are most conducive to Lean Six Sigma's successful deployment. The Lack of differentiation among industry sectors such

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as manufacture and services. A different leadership style may be required in other industry sectors and across organizations of quite different sizes. Lack of results, the most variation of each paper's goals, and the variation that depends on six Sigma will be used on industry condition.

For future research, Lean Six Sigma collects data to attain its goal. Collected data should be analyzed to create an optimum and proper decision. However, Industry 4.0 technologies change to gather an enormous amount of information. Therefore, traditional data analysis techniques do not seem sufficient because they require more time and value. It is possible to profit from advanced techniques suitable for extensive data, like big data analytics and process mining, and traditional methods to create effective decisions, shown in Figure 6. In future research, Collaboration of 3 components, Six Sigma, Lean manufacturing, and industry 4.0, can provide a guide that makes easier, faster, more reliable, and satisfied decisions with data for improving quality in processes.

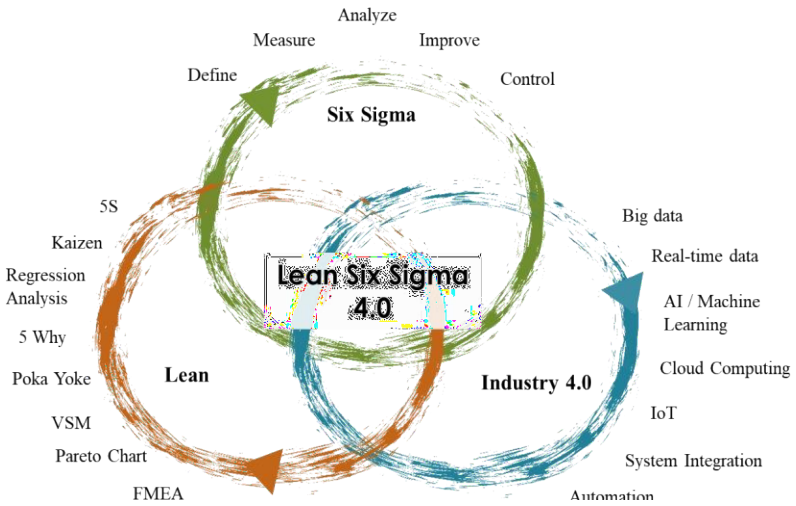

Fig. 5 Future Research Framework

4. Conclusion

Lean Six Sigma approach is a structured and systematic methodology for improving a process focused on reducing process variance as much as possible, minimizing defects (products/services that fall outside of specifications) by using statistics and problem-solving tools intensively. Six Sigma's primary focus as a management system is on three things: the focus on customers, processes, and data management. This paper identifies that of the 50 journals analyzed, almost all of them can improve the quality of products produced or manufacturing companies' processes. This is a benchmark for manufacturing companies to provide an overview of tools for solving quality-related problems. Because with improvements with the lean six sigma approach, companies can get many benefits, including changes in product and service quality, increased productivity, lower costs, reduced defective products, and problems that can be resolved quickly. This paper suggests that Six Sigma can be applied in the SME industrial sector because financial SMEs often experience obstacles.

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DOI 10.21776/ub.jemis.2021.009.002.3

References

[1] Winters-Miner, L. A., Bolding, P., Hill, T., Nisbet, B., Goldstein, M., Hilbe, J. M., Walton, N., Miner, G., & Dean, D. (2015). Root Cause Analysis, Six Sigma, and Overall Quality Control and Lean Concepts. *Practical Predictive Analytics and Decisioning Systems for Medicine*, 143–164. https://doi.org/10.1016/b978-0-12-411643-6.00011-9

[2] Wang, F. K., Yeh, C. T., & Chu, T. P. (2016). Using the design for the Six Sigma approach with TRIZ for new product development. *Computers and Industrial Engineering*, *98*, 522–530. https://doi.org/10.1016/j.cie.2016.06.014

[3] Pereira, M. T., Inês Bento, M., Ferreira, L. P., Sá, J. C., & Silva, F. J. G. (2019). Using Six Sigma to analyze Customer Satisfaction at the product design and development stage. *Procedia Manufacturing*, *38*(2019), 1608–1614. https://doi.org/10.1016/j.promfg.2020.01.124

[4] Vincent Gaspersz. (2002). *Pedoman Impementasi Program Six Sigma* (A. Purwanto (ed.); Pertama). PT. Gramedia Pustaka Utama.

[5] Kurniawan, A. R., & Prestianto, B. (2020). Perencanaan Pengendalian Kualitas Produk Pakaian Bayi dengan Metode Six Sigma PadaCV. AGP. *JEMAP*. https://doi.org/10.24167/jemap.v3i1.2632

[6] Haryanto, E., & Ichtiarto, B. P. (2020). ANALISA PENURUNAN CACAT (defect) CAT BINTIK DEBU DENGAN METODOLOGI SIX SIGMA PADA PROSES PAINTING PRODUK FUEL TANK DI PT. SSO TANGERANG. *Jurnal PASTI*. https://doi.org/10.22441/pasti.2019.v13i3.009

[7] Kaswan, M. S., & Rathi, R. (2020). Green Lean Six Sigma for sustainable development: Integration and framework. *Environmental Impact Assessment Review*, *83* (November 2019),106396. https://doi.org/10.1016/j.eiar.2020.106396

[8] Costa, L. B. M., Godinho Filho, M., Fredendall, L. D., & Ganga, G. M. D. (2020). The effect of Lean Six Sigma practices on food industry performance: Implications of the Sector's experience and typical characteristics. *Food Control*, *112*(November 2019), 107110. https://doi.org/10.1016/j.foodcont.2020.107110

[9] Niñerola, A., Sánchez-Rebull, M. V., & Hernández- Lara, A. B. (2020). Quality improvement in healthcare: Six Sigma systematic review. *Health Policy*, *124*(4), 438–445. https://doi.org/10.1016/j.healthpol.2020.01.002

[10] Reaz, M., Repon, U., Sadia, H. T., & Hanif, F. (2020). *Quality improvement in readymade garments industry by traffic light system Analysis of the effectiveness and durability of high- performance textiles View project Assessment of fastness properties of knitted cotton fabric dyed with natural dyes View project*. https://doi.org/10.15406/jteft.2020.06.00235

[11] Huda, A. S. W. (2020). Analisis Pengendalian Kualitas Proses Pengelasan (Welding) Dengan Pendekatan Six Sigma Pada Proyek Pt.Xyz. *Wacana Ekonomi*.

[12] Fitri, P. (2019). SIX SIGMA SEBAGAI ALAT PENGENDALIAN MUTU PADA HASIL PRODUKSI KAIN MENTAH PT UNITEX, TBK. *J@ti Undip : Jurnal Teknik Industri*. https://doi.org/10.14710/jati.14.1.43-52

[13] Aina Nindiani, Robi Nursikin, Ali Kustia, Tedi Sertiadi, Ni Wayan Puji, & Wahyudi. (2019). PENURUNAN CACAT PRODUK GARNISH-ASSEMBLY TAILGATE DI PERUSAHAAN OTOMOTIF MELALUI PENDEKATAN METODE DMAIC. *Industry Xplore*. https://doi.org/10.36805/teknikindustri.v4i1.604

[14] Erdil, A. (2019). An Evaluation on Lifecycle of Products in Textile Industry of Turkey through Quality Function Deployment and Pareto Analysis. *Procedia Computer Science*, *158*, 735–744. https://doi.org/10.1016/j.procs.2019.09.109

[15] Lajoie, P., Gaudreault, J., Lehoux, N., & Ali, M. Ben. (2019). A data-driven framework to deal with intrinsic variability of industrial processes: An application in the textile industry. *IFAC- PapersOnLine*, *52*(13), 731–736. https://doi.org/10.1016/j.ifacol.2019.11.202

[16] Gaur, K. (2019). Systematic and quantitative assessment and application of FMEA and Lean six Sigma for reducing non-productive time in a Tertiary Care Hospital's operation theatre in a metropolis. *Perioperative Care and Operating Room Management*, *16*(December 2018), 100075. https://doi.org/10.1016/j.pcorm.2019.100075

[17] Goyal, A., Agrawal, R., & Saha, C. R. (2019). Quality management for sustainable manufacturing: Moving from number to impact of defects. *Journal of Cleaner Production*, *241*, 118348. https://doi.org/10.1016/j.jclepro.2019.118348

e-ISSN 2477-6025
DOI 10.21776/ub.jemis.2021.009.002.3

[18] Costa, J. P., Lopes, I. S., & Brito, J. P. (2019). Six Sigma application for quality improvement of the pin insertion process. *Procedia Manufacturing*, *38*(2019), 1592–1599. https://doi.org/10.1016/j.promfg.2020.01.126

[19] Nørup, N., Pihl, K., Damgaard, A., & Scheutz, C. (2019). Quantity and quality of clothing and household textiles in Danish household waste.*Waste Management*, *87*, 454–463. https://doi.org/10.1016/j.wasman.2019.02.020

[20] Neutze, D. M., & Stortz, L. (2018). Quality improvement. In *Chronic Illness Care: Principles and Practice*. https://doi.org/10.1007/978-3-319-71812-5-35

[21] Söylemez, M., & Tarhan, A. (2018). Challenges of software process and product quality improvement: catalyzing defect root-cause investigation by process enactment data analysis.*Software Quality Journal*. https://doi.org/10.1007/s11219-016-9334-6

[22] Wu, B., Pan, Z., Ding, D., Cuiuri, D., Li, H., Xu, J., & Norrish, J. (2018). A review of the wire arc additive manufacturing of metals: properties, defects and quality improvement. In the *Journal ofvManufacturing Processes*. https://doi.org/10.1016/j.jmapro.2018.08.001

[23] Roesmasari, R. A., Santoso, I., & Sucipto, S. (2018). STRATEGI PENINGKATAN KUALITAS LEATHER DENGAN METODE LEAN SIX SIGMA DAN FUZZY FMEA (STUDI KASUS DI SUMBER REJEKI). *Jurnal Teknologi Pertanian*. https://doi.org/10.21776/ub.jtp.2018.019.03.5

[24] Nasution, S., & Sodikin, R. D. (2018). Perbaikan Kualitas Proses Produksi Karton Box Dengan Menggunakan Metode DMAIC Dan Fuzzy FMEA. *Jurnal Sistem Teknik Industri*. https://doi.org/10.32734/jsti.v20i2.488

[25] Didiharyono, D., Marsal, M., & Bakhtiar, B. (2018). Analisis Pengendalian Kualitas Produksi Dengan Metode Six-Sigma Pada Industri Air Minum PT Asera Tirta Posidonia, Kota Palopo. *Sainsmat : Jurnal Ilmiah Ilmu Pengetahuan Alam*. https://doi.org/10.35580/sainsmat7273702018

[26] Elza, F., & Santosa, A. (2017). Analisis Six Sigma untuk Mengurangai Jumlah Cacat Sepatu di PT. Primarindo Asia Infrastructure, Tbk. *Prosiding Saintiks FTIK UNIKOM*.

[27] Rimantho, D., & Mariani, D. M. (2017). Penerapan Metode Six Sigma Pada Pengendalian Kualitas Air Baku Pada Produksi Makanan. *Jurnal Ilmiah Teknik Industri*. https://doi.org/10.23917/jiti.v16i1.2283

[28] Supriyadi, S., Ramayanti, G., & Chandra Roberto, A. (2017). Analisis Kualitas Produk dengan Pendekatan Six Sigma. *Prosiding SNTI Dan SATELIT 2017 1 (Teknik Industri Universitas Brawijaya)*. https://doi.org/DOI10.17605/OSF.IO/UVPEZ

[29] Ekawati, R., & Rachman, R. A. (2017). Analisa Pengendalian Kualitas Produk Horn PT. MI Menggunakan Six Sigma. *Jurnal Industrial Services*.

[30] Costa, T., Silva, F. J. G., & Pinto Ferreira, L. (2017). Improve the extrusion process in tire production using Six Sigma methodology. *Procedia Manufacturing*, *13*,1104–1111. https://doi.org/10.1016/j.promfg.2017.09.171

[31] Bakar, A., Suprianto, O., & Yuniati, Y. (2017). USULAN PENINGKATAN PRODUKTIVITAS BERDASARKAN METODE MUNDEL DAN APC DI PT RAFFSYA MEDIA. *Journal of Industrial Engineering Management*. https://doi.org/10.33536/jiem.v2i2.147

[32] Sihombing, M. I. S., & Sumartini, S. (2017). Pengaruh Pengendalian Kualitas Bahan Baku dan Pengendalian Kualitas Proses Produksi terhadap Kuantitas Produk Cacat dan Dampaknya pada Biaya Kualitas (Cost of Quality). *JURNAL ILMU MANAJEMEN DAN BISNIS*. https://doi.org/10.17509/jimb.v8i2.12665

[33] Nurprihatin, F., Yulita, N. E., & Caesaron, D. (2017). Usulan Pengurangan Pemborosan pada Proses Penjahitan Menggunakan Metode Lean Six Sigma. Prosiding Seminar Nasional Akuntansi Dan Bisnis.

[34] Adikorley, R. D., Rothenberg, L., & Guillory, A. (2017). Lean Six Sigma applications in the textile industry: a case study. *International Journal of Lean Six Sigma*, *8*(2). https://doi.org/10.1108/ijlss-03-2016-0014

[35] Widiyawati, S., & Assyahlafi, S. (2017). PerbaikanProduktivitas Perusahaan Rokok Melalui Pengendalian Kualitas Produk dengan Metode Six Sigma. *Journal of Industrial Engineering Management*. https://doi.org/10.33536/jiem.v2i2.150

[36] Pratiwi, A. I., Husna, S., & Syukri, A. (2016). PENDEKATAN METODE LEAN SIX SIGMA (DMAIC) DAN CUMULATIVE SUM UNTUK PENINGKATAN KUALITAS KAIN GREI PADA DEPARTEMEN SHUTTLE II (STUDI KASUS DI PC GKBI YOGYAKARTA). *Seminar Nasional IENACO –*.

[37] Jardini, A. L., Larosa, M. A., Macedo, M. F., Bernardes, L. F., Lambert, C. S., Zavaglia, C. A.

e-ISSN 2477-6025
DOI 10.21776/ub.jemis.2021.009.002.3

C., Filho, R. M., Calderoni, D. R., Ghizoni, E., & Kharmandayan, P. (2016). Improvement in Cranioplasty: Advanced Prosthesis Biomanufacturing. *Procedia CIRP*. https://doi.org/10.1016/j.procir.2015.11.017

[38] Nakamura, T., Takahashi, Y., Tanaka, Y., Asano, T.,& Noda, S. (2016). Improvement in the quality factors for photonic crystal nanocavities via visualization of the leaky components. *Optics Express*. https://doi.org/10.1364/oe.24.009541

[39] Danny Dharmawan, L., & Ekawati, Y. (2016). Peningkatan Kualitas Knalpot Pada Pt Fajar Indah Menggunakan Metode Six Sigma. *Jurnal Teknik Industri*. https://doi.org/10.22219/jtiumm.vol15.no2.112-123

[40] Pugna, A., Negrea, R., & Miclea, S. (2016). Using Six Sigma Methodology to Improve the Assembly Process in an Automotive Company. *Procedia - Social and Behavioral Sciences*, *221*, 308–316. https://doi.org/10.1016/j.sbspro.2016.05.120

[41] Eleftheriadis, R. J., & Myklebust, O. (2016). A guideline of quality steps towards zero-defect manufacturing in the industry. *Proceedings of the International Conference on Industrial Engineering and Operations Management*.

[42] F, Hutami, R. R., & Yunitasari, C. (2016). Analisis Pengendalian Kualitas Produk Dengan Metode Six Sigma Pada Perusahaan Percetakan PT Okantara *Kinerja*. https://doi.org/10.24002/kinerja.v20i1.699

[43] Wardana, W., Harsono, A., & Liansari, G. P. (2015). Implementasi Perbaikan Kualitas Menggunakan Metode Six Sigma Untuk Mengurangi Jumlah Cacat Produk Sajadah Pada Perusahaan Pt.Pondok Tekstil Kreasindo. *Jurnal Online Institut Teknologi Nasional.*

[44] Prasetyo, E. D. (2015). Analisa produksi pada Aerosol CAN Ø 65 X 124 dengan Menggunakan Metode Pendekatan Six Sigma Pada Line ABM 3 Departemen Assembly PT. XYZ. *PASTI.*

[45] Harpensa, A., Harsono, A., & Fitria, L. (2015). USULAN PERBAIKAN KUALITAS MENGGUNAKAN METODE SIX SIGMA UNTUK MENGURANGI JUMLAH CACAT PRODUK UBIN TERASO PADA PT. UBIN ALPEN. *Jurnal Online Institut TeknologiNasional*.

[46] Salomon, L. L., Ahmad, & Limanjaya, N. D. (2015).Strategi Peningkatan Mutu Part Bening Menggunakan Pendekatan Metode Six Sigma. Jurnal Ilmiah Teknik Industri (2015).

[47] Indrawati, S., & Ridwansyah, M. (2015). Manufacturing Continuous Improvement Using Lean Six Sigma: An Iron Ores Industry Case Application. *Procedia Manufacturing*, *4*(I), 528–534. https://doi.org/10.1016/j.promfg.2015.11.072

[48] Alkatiri, H. A., Adianto, H., & Novirani, D. (2015). Implemetasi Pengendalian Kualitas Untuk Mengurangi Jumlah Produk Cacat Tekstil Kain Katun Menggunakan Metode Six Sigma Pada Pt. Ssp. *Jurnal Online Institut Teknologi Nasional*.

[49] Rahmiyati, N., & Rahim, M. A. (2015). Peningkatan Produktivitas Dan Kualitas Produk Melalui Penerapan Teknologi Tepat Guna Pada Usaha Pengembang Ekonomi Lokal Di Kota Mojokerto Propinsi Jawa Timur. Jurnal Pengabdian LPPM Untag Surabaya. https://doi.org/10.22441/pasti.2019.v13i3.009

[50] Wisnubroto, P. (2015). Dan Analisis Kaizen Serta New Seven Tools Sebagai Usaha Pengurangan Kecacatan Produk. *Jurnal Teknik Industri ISTAkprind*.

[51] Boon Sin, A., Zailani, S., Iranmanesh, M., & Ramayah, T. (2015). Structural equation modelling on knowledge creation in the Six Sigma DMAIC project and its impact on organizational performance. *International Journal of Production Economics*, *168*, 105–117.https://doi.org/10.1016/j.ijpe.2015.06.007

[52] Jevgeni SEduard SRoman Z. (2015). Framework for continuous improvement of production processes and product throughput. *Procedia Engineering*, *100*(January), 511–519. https://doi.org/10.1016/j.proeng.2015.01.398