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Lean Assessment of Manufacturing Setup Case Study: Heavy Mechanical Complex Hydraulic shop, Pakistan

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ABSTRACT: Lean manufacturing (LM) has been used widely in the last decades for the continuous improvement of existing production system. Lean assessment tool (LAT), one of the recognized LM tool, is used for assessing the overall performance of Lean practices within a system. The purpose of this study is to assess the lean implemented in local industries followed by identification of weak areas in this aspect. Lean assessment has been done by developing a lean assessment questionnaire. The questionnaire includes three major areas: (i) Technology management, (ii) System management and (iii) people management. Likert scale was employed to measure the leanness of industries. Total number of ten industries were visited and their leanness was evaluated. SPSS was employed for analysis of gathered data. The survey results indicated that industries strongly incorporate (i) small lot production in technology management, (ii) total employee involvement in people management and (iii) level load and balance flow in system management. The weak areas identified from the survey include (i) structure flow in technology management, (ii) preventive maintenance in system management, and (iii) housekeeping & control through visibility in people management. In addition, Culture awareness and training centre were identified as weak areas which need improvement A case study of HMC Hydraulic shop has been taken to implement lean tools in industry. For implementation of lean, two analysis techniques including interpretive structural modelling (ISM) and Cross Impact Matrix Multiplication Applied to Classification (MICMAC) analysis will be employee to measure the effective of proposed lean system.

Keywords: Lean Management, 5S, Lean Assessment, Structural Modelling

I. BACKGROUND

In the current era of globalization, manufacturing industries are facing a considerable amount of pressure due to customer expectations about product quality, demand responsiveness, lower cost and product variety (Ahrens, 2006)(Omogbai & Salonitis, 2016). To meet such expectations, 75% of organizations currently employ some type of process improvement strategies (Karvonen et al., 2012)(Salem et al., 2005). Lean manufacturing is regarded as a manufacturing philosophy that, if adopted and carefully implemented, can undoubtedly form the roadmap to global manufacturing excellence (Doolen & Hacker, 2005)(Sidhu et al., 2013). It also offers a solution for cost reduction strategies like the identification and elimination of waste in manufacturing environments. It is targeted towards incorporating less human effort, less inventory, less time to develop products, and less space to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible. (Salem et al., 2005) stated that organizations who have successfully implemented lean strategies have achieved noticeable results(Thanki & Thakkar, 2018). Some have even argued that as a result of global competition, organizations that are not lean may not survive. Lean initiatives are now common in all facets of business (Karvonen et al., 2012). In the country like Pakistan lean is just studies in institutes. There is no little awareness in government organization, they even don't know that what is meant by "lean". And how it could be possible to implement it in organization that's are continuously lose their values and market(Amin, 2013)(Taninecz, 2019). Lean manufacturing is substitutable with a set of practices used in the identification and the removal of waste related with the manufacturing system and create an efficient and effective environment, and also focusing on what creates value for the customer. It is becoming more and more best-selling among companies and public institutions. Customer satisfaction is become a core value for all organization(Wickramasinghe

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& Wickramasinghe, 2017). With increasing awareness customers are demanding more with high quality but at low cost and with no waiting, added to fulfill this critical expectation of customers is the ever increasing competition due to globalization. To meet the customer demands organizations are looking to find ways of investing less resources to achieve more. To meet organization findings and customers demand lean is possible way to meet both of these. Lean offers a series of tools, techniques and models as well for the continuous improvement of organizations objective and mission(Hallam & Keating, 2014). The lean management draw close to be the most effective in term of achieving effective and efficient productivity and relatively fast manner(Karvonen et al., 2012). Lean manufacturing idea was originated from the Japanese automaker, Toyota Motor Company and Toyota Production System (TPS)(Ahrens, 2006)(Urban, 2015). TPS evolved as an alternative to the existing mass production system due to the necessity of overcoming the three daunting challenges faced by it after World War II(Kennedy, 2011). The challenges were: i. To provide for the needs of a domestic market which was not only small but demanded high product variety ii. Inability of the capital-starved company to make huge investments in western technologies iii. To compete with well-established foreign brands such as General Motors and Ford(Marodin et al., 2019). There was a lack of resources after World War II in the Toyota Motor Company. The TPS, also known as Just-In-Time (JIT) was developed to survive with the minimum amount of resources during that time(Mirzaei, 2011). All mistakes were unaffordable, and reduction of wastes on the shop floor became the mission of survival due to the limited availability of resources. The oil crisis struck the global economy especially in North America in 1973. However, Toyota sustained and prospered because of the high efficiency of the TPS(Gonçalves & Salonitis, 2017). As a result, the lack of resources, which was originally an obstacle for this company, turned out to be the stepping stone for them to become a world-class manufacturer(Ogunbiyi, 2014).

Lean Assessment Model/Approach	Authors	Input Data Type	Strength	Weakness
Value Stream Mapping Approach	(Hines & Rich, 1997a), (Rother & Shook, 1998)	Qualitative	Effective mapping tool focuses on creating continuous value stream	No integrated me the overall leanne
LESAT	(Nightingalea & Mizeb, 2002)	Qualitative	Can assess the overall leanness level based on different lean constructs (e.g. People, operations, quality, suppliers and the customers)	The output is subj based on individu Judgements
Soriano-Meir and Forrester Model	(Soriano-Meier & Forrester, 2002)			
Chinese Hi-Tech Model	(Taj, 2005; Taj & Morosan, 2011)			
Balanced Score Card	(Sánchez & Pérez, 2001)			
Shah and Ward Model	(Shah & Ward, 2007)			
RPA Model	(Goodson, 2002)			
Manufacturing Cycle Efficiency Model	(Levinson & Rerick, 2002)	Quantitative	Assessing leanness level quantitatively based on the actual performance	Although an integ of metrics are req measure the overa level, synthesizin metrics in one int leanness measure due to their differ and measurement
Discrete Event Simulation	(Detty & Yingling, 2000)			
Value Added index	(Fogarty, 1992)			
Labour Productivity	(Hiroshi Katayama & David Bennett, 1999)			
Data Envelopment Analysis	(Wan & Chen, 2008)	Quantitative	Quantitatively measure the overall leanness comparing the system's state with benchmarking performance	Exemplar perforn benchmark needs collected from pe competitors. In ac outcome is heavil depending on the the benchmark
Mahalanobis Taguchi Gram	(Srinivasaraghavan & Allada, 2006)			
Schmitt System				
Fuzzy Logic Methodology	(Bayou & de Korvin, 2008; Vinodh & Chintha, 2010b)			
Benchmarking Lean Assessment	(Gurumurthy & Kodali, 2009)			

II. RESEARCH METHODOLOGY

This chapter describes the research methodology adopted in this research. The

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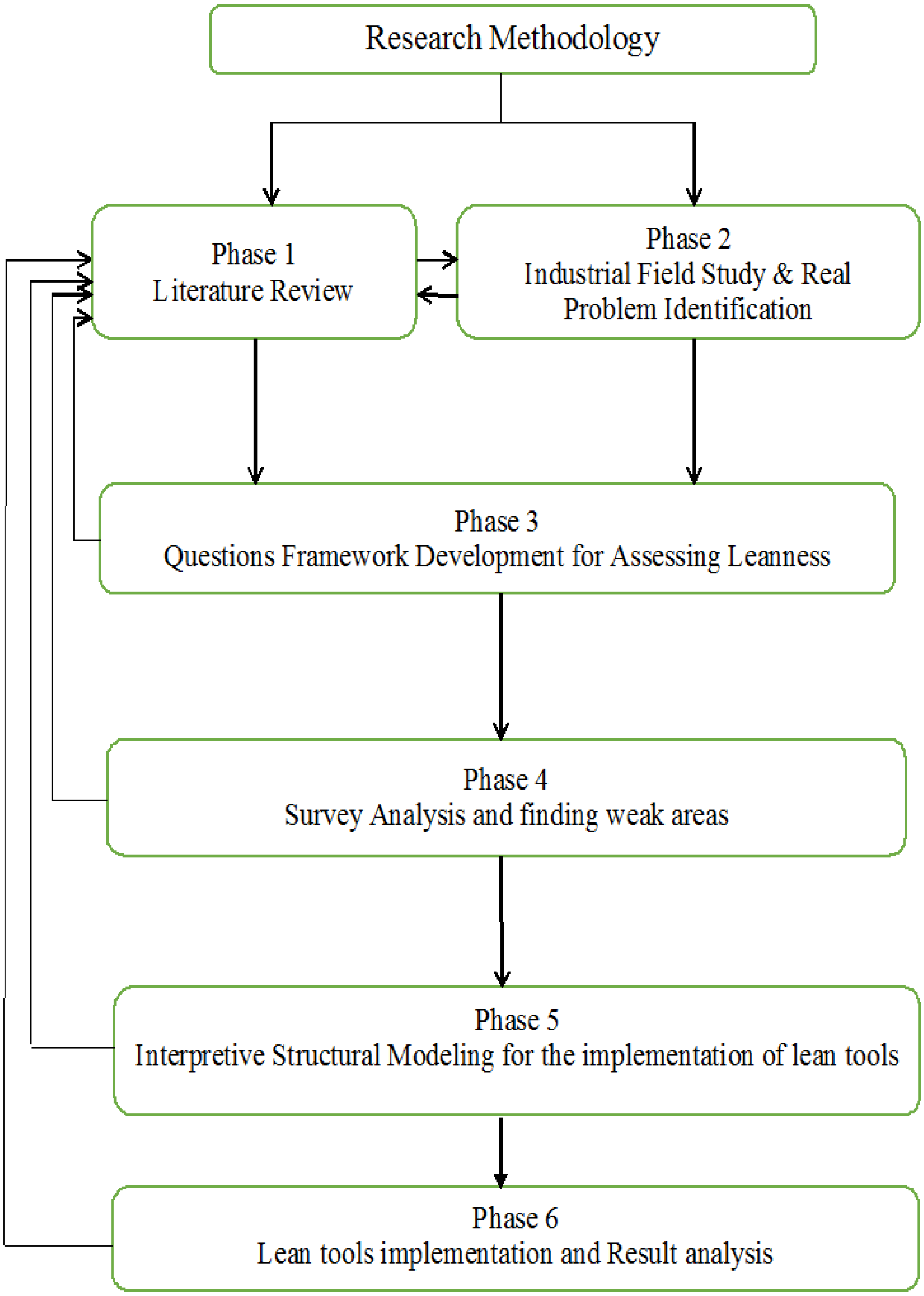
objectives of this research are: • To develop mathematical models and a systematic methodology for selecting appropriate lean strategies for manufacturing organizations within their resource constraints • To develop a leanness assessment model to evaluate the overall leanness level and set a leanness benchmark • To develop a decision, support tool: a tool for selecting lean strategies and assessing leanness for lean practitioners to track and sustain the lean implementation efforts. This research employed a deductive approach to test and validate the proposed mathematical models and methodologies. The research method undertaken to achieve the above objectives is presented in Figure 3.1 and described below.



Heavy Mechanical Complex Taxila was selected for Lean assessment and implementation of 5S. The purpose of this study is to assess the lean implemented in local industries followed by identification of weak areas in this aspect. After problem identification the questionnaire is developed on the basis of weak areas. Likert scale is followed. An assessment tool is used to evaluate actual manufacturing practice related to key areas of inventory; team approach; processes; maintenance; layout/handling; suppliers; setups; quality; and scheduling and control. Manufacturing executives at manufacturing plants answered of all questions in the assessment. Each response in the assessment is scored and a total score for each plant is recorded by adding average scores for all areas. The Lean Manufacturing Assessment is divided into fourteen (14) areas: 1. Cultural Awareness 2. Structured Flow Manufacturing 3. Small Lot Production 4. Setup Reduction 5. Fitness for Use 6. Employee Involvement 7. Control through Visibility 8. Housekeeping/Workplace Organization 9. Total Quality Focus 10. Level Load and Balanced Flow 11. Preventive Maintenance 12. Supplier Partnerships 13. Pull Systems 14. Education and Training Likert scale is followed for development of questionnaire on the bases of above 14 areas. An assessment tool is used to evaluate actual manufacturing practice related to key areas of inventory; team approach; processes; maintenance; layout/handling; suppliers; setups; quality; and scheduling and control. Manufacturing executives at manufacturing plants answered of all questions in the assessment. Each response in the assessment is scored and a total score for each plant is recorded by adding average scores for all areas. The format used for assessment or evaluation of lean in organization

Table 4-1: Data Collection from the Ten firms

	HMC	**Shah Engineering works**	**venus Carpet**	**enterloopFsd**	**Volta bettry**	**KSB pump**	**Kohenoor RWP**	**Bestway cement**	**Syyed Engineering**	**Jame-shirin**
Structure Flow	2.78	4.43	3.37	3.68	4.10	2.5	5.0	2.5	5.00	4.57
Small lot Production	3.67	5.00	5.22	7.00	4.56	3.00	5.00	3.00	4.56	5.22
Setup Reduction	2.75	7.00	5.00	4.33	5.00	1.86	4.50	1.86	5.00	5.00
Fitness for Use	2.50	6.25	4.50	6.25	4.00	2.75	5.29	2.75	4.00	4.50
Total Employee Involvement	3.0	5.0	8.0	5.0	5.5	2.33	5.50	2.33	5.5	4.0
Control Through Visibility	2.3	4.1	4.6	6.7	4.4	3.00	2.33	3.00	4.4	3.6
Housekeeping	1.8	3.3	2.3	5.7	3.7	1.20	5.67	1.20	3.7	2.3
Total Quality Focus	2.5	5.4	5.0	5.4	4.6	5.57	4.6	5.57	5.86	5.86
Level Load and Balance Flow	3.00	6.00	5.00	6.00	4.25	5.22	4.25	2.78	5.00	5.00
Preventive maintenance	1.86	4.75	4.50	3.73	4.00	3.19	2.89	3.67	4.31	4.30
Supplier Partnership	2.75	5.86	5.29	5.57	4.71	4.50	4.71	2.75	6.25	6.25
Pull System	2.33	5.25	5.50	5.00	5.75	8.0	5.75	2.50	5.0	4.7
Culture awareness	3.00	4.67	2.33	4.47	4.33	4.9	4.33	3.0	4.1	4.1
Training center	1.20	4.33	5.67	6.11	3.89	2.3	3.89	2.3	3.3	3.3

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III. RESULTS AND ANALYSIS

The data which is collected from survey of 10 industries is given below the bases of this collected data spider chart is developed which explains the strong areas where no improvement is needed and weak areas where less or no more lean is implemented and they need improvements.

As according to Likert scale, the questionnaire was marked from 1 to 9. In which 0 means no lean implementation, 3 means 25% lean implementation, 5 means 50% lean implementation, 7 means 75% lean implantation and 9 means 100% implantation. So on the bases of this grading lean assessment of 10 has been done. The organization lean percentage is given below in the graph and in the graph-1 there is shown of overall leanness percentage score by using Likert scale for evaluation. In data analysis phase, data collected through audit and direct observation of the production cells. The overall leanness was calculated based on the accomplishment of each maturity level's requirements. And for analysis of data two software are applied, Excel is used for analyzing of data, and check the overall leanness score of organization and critical areas where it need to be special improvement by using lean strategies or lean tools. And other software used for analysis of collected data is SPSS software a special advance tool of this software SPAW is used and analyze the result. In SPSS advance tool SPAW. Data are input by providing scale value, and data type is as input. By using analyze from the tool bar and chose the scale and then reliability, to find the Cronbach alpha value and in case of evolution if the alpha value is equal or less than >= 0.7 it is considering to be as critical area and find some improvements to remove problems or weak areas.

Table 5. 1:Data collection and average value of each area and organization

Areas	1	2	3	4	5	6	7	8	9	10	Total average score
Structure Flow	2.78	4.43	3.37	3.68	4.10	2.5	5.0	2.5	5.00	4.57	3.79
Small lot Production	3.67	5.00	5.22	7.00	4.56	3.00	5.00	3.00	4.56	5.22	4.62
Setup Reduction	2.75	7.00	5.00	4.33	5.00	1.86	4.50	1.86	5.00	5.00	4.23
Fitness for Use	2.50	6.25	4.50	6.25	4.00	2.75	5.29	2.75	4.00	4.50	4.28
Total Employee Involvement	3.0	5.0	8.0	5.0	5.5	2.33	5.50	2.33	5.5	4.0	4.62
Control Through Visibility	2.3	4.1	4.6	6.7	4.4	3.00	2.33	3.00	4.4	3.6	3.86
Housekeeping	1.8	3.3	2.3	5.7	3.7	1.20	5.67	1.20	3.7	2.3	3.09
Total Quality Focus	2.5	5.4	5.0	5.4	4.6	5.57	4.6	5.57	5.86	5.86	5.04
Level Load and Balance Flow	3.00	6.00	5.00	6.00	4.25	5.22	4.25	2.78	5.00	5.00	4.65
Preventive maintenance	1.86	4.75	4.50	3.73	4.00	3.19	2.89	3.67	4.31	4.30	3.72
Supplier Partnership	2.75	5.86	5.29	5.57	4.71	4.50	4.71	2.75	6.25	6.25	4.86
Pull System	2.33	5.25	5.50	5.00	5.75	8.0	5.75	2.50	5.0	4.7	4.98

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Culture awareness	3.00	4.67	2.33	4.47	4.33	4.9	4.33	3.0	4.1	4.1	3.93
Training center	1.20	4.33	5.67	6.11	3.89	2.3	3.89	2.3	3.3	3.3	3.64
Average score	2.53	5.10	4.74	5.35	4.48	3.60	4.55	2.80	4.72	4.49	

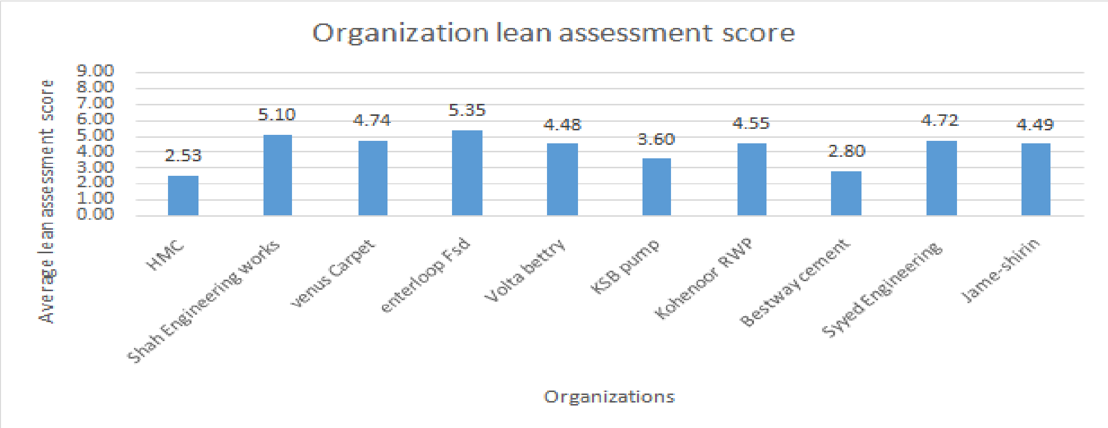

Figure 5-1: Organizational Lean assessment score

In this bar graph the organizations having less than 5.00 are consider to be in a critical condition these value show the percentage of leanness of each organization. Only few of these ten firms have more than 5.00 which are not fully using lean strategies. A radar chart and bar graph are shown below showing the most critical areas for the absence of lean implementation in the firms. Maximum value is 9 and areas having less than of the half value of 9 are also considering as critical areas. And these critical areas are (i) culture awareness (ii) training center (iii) preventive maintenance (iv) housekeeping (v) control through visibility and (vi) structural flow of manufacturing setups. If we looking at the basic major areas Technology management, system management and people management then from the analysis it is shown that most of the problems occur while roadmap to lean culture or lean thinking is due to people management this is due to other two additional areas which are not included in these major areas. But very important for transformation of firms towards the lean. All the problems are due to the culture awareness and training center because firms are not interested toward the lean implementation and they don't pay attention toward these two major cause which are very important for developing a lean culture environment. In the firms. By creating a culture that is totally based on lean thinking will transform the firms from scrap to successful competitors in global market to compete their competitors.

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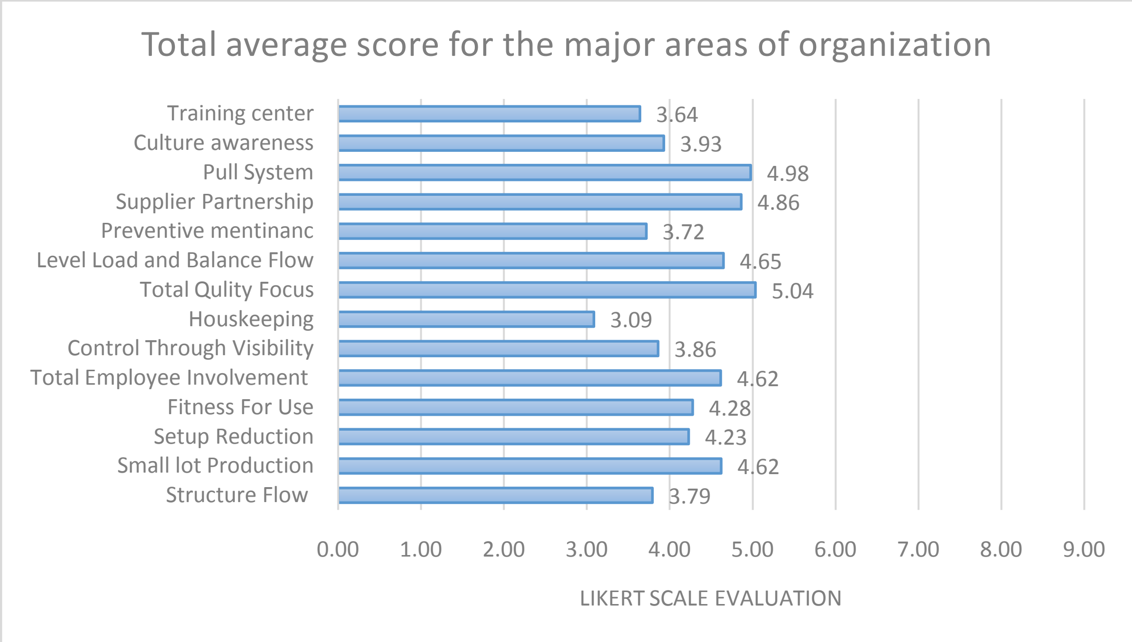

Figure 5-2: Bar graph showing weak areas after lean assessment

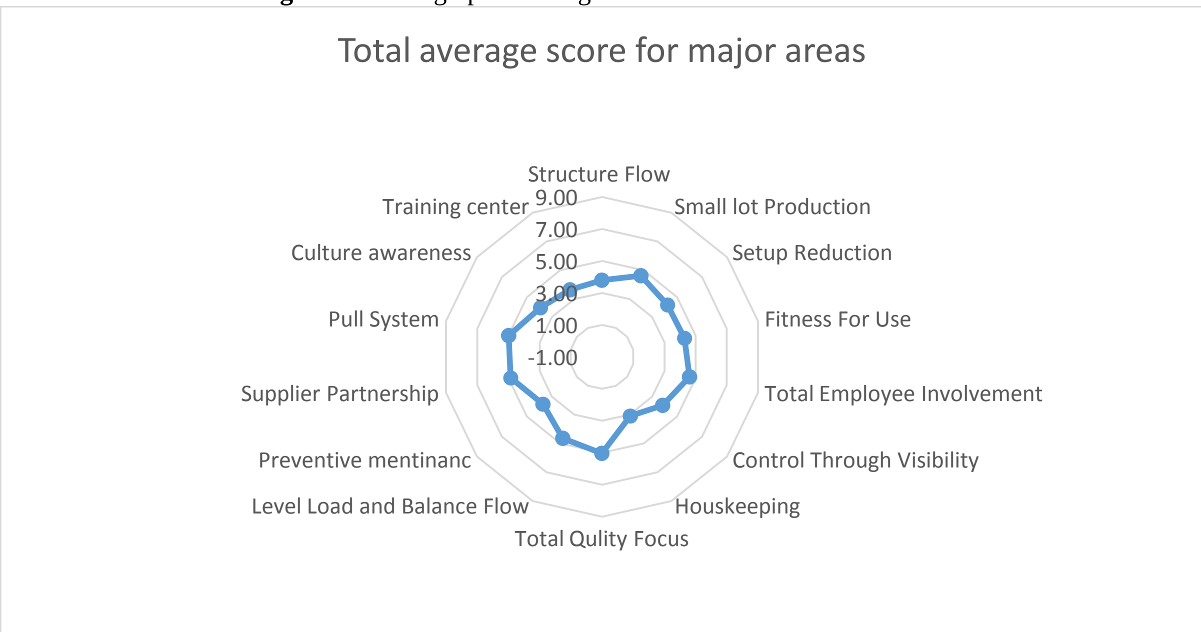

Figure 5-3: Radar chart showing the weak areas having less scores

SPSS software is a statistical software for analyzing the qualitative data. In this simply put the data collected from the observation and direct interview with firm's employees that have some knowledge about lean. After inserting data in software select the analyze option in the menu bar and then chose the scale option, then further chose the reliability option and press enter button. By choosing all sub areas of technology management firstly analyzed, and find the value of Cronbach alpha value if it is less than the given criteria then it considers to be as critical area and there need lean tools implementation to improve this area for continuous improvement.

Technology Management

Table 5. 2: Technology management Cronbach alpha value.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Structure Flow	**7.4000**	**4.267**	**.354**	**.198**	**.734**
Small lot Production	7.0000	3.778	.452	.465	.688
Setup Reduction	7.4000	2.933	.569	.570	.614
Fitness for Use	7.6000	2.044	.737	.675	.489

People Management

Table 5. 3: People management Cronbach alpha value.

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Total Employee Involvement	6.2000	2.178	.585	.475	.474
Control Through Visibility	**6.6000**	**2.933**	**.526**	**.568**	**.557**
Housekeeping	**6.8000**	**2.622**	**.367**	**.467**	**.648**
Total Quality Focus	5.9000	2.989	.331	.575	.658

System Management

Table 5-Error! No text of specified style in document.-2: System management Cronbach alpha value should be

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Level Load and Balance Flow	6.6000	3.156	.680	.570	.644
Preventive maintenance	**7.2000**	**4.400**	**.427**	**.277**	**.780**
Supplier Partnership	6.7000	2.678	.734	.641	.598
Pull System	6.5000	2.722	.520	.278	.759

Additional areas

Table 5. 4: culture awareness & training center Cronbach alpha value.

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Culture awareness	**1.9000**	**.544**	**.027**	**.001**	**.[a]**
Training center	**2.1000**	**.322**	**.027**	**.001**	**.[a]**

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a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item coding's.

And the final result showing the critical areas

Main areas		Cronbach Alpha
Technology Management	Structure Flow	0.717
	Small lot Production	
	Setup Reduction	
	Fitness for Use	
People Management	Total Employee Involvement	0.658
	Control Through Visibility	
	Housekeeping	
	Total Quality Focus	
System Management	Level Load and Balance Flow	0.761
	Preventive maintenance	
	Supplier Partnership	
	Pull System	
	Culture Awareness	0.05
	Training Center	

Table 5. 5: Final result showing the Cronbach alpha value

As seen from the above table in people management and additional two culture awareness and training center have less value of Cronbach alpha value and according to the given criteria minimum value is >=0.7 for normal case but if value is less than of this then there take a serious action to remove problems as it values reach in negative then it also be considering as the critical areas. The figure below shows the weak area and cause for this also mention in this figure which are brainstormed and study from the literature. These further cause are also known as lean barriers that are known as hurdler when lean strategies are implementing.

Interpretive Structure Modeling Results

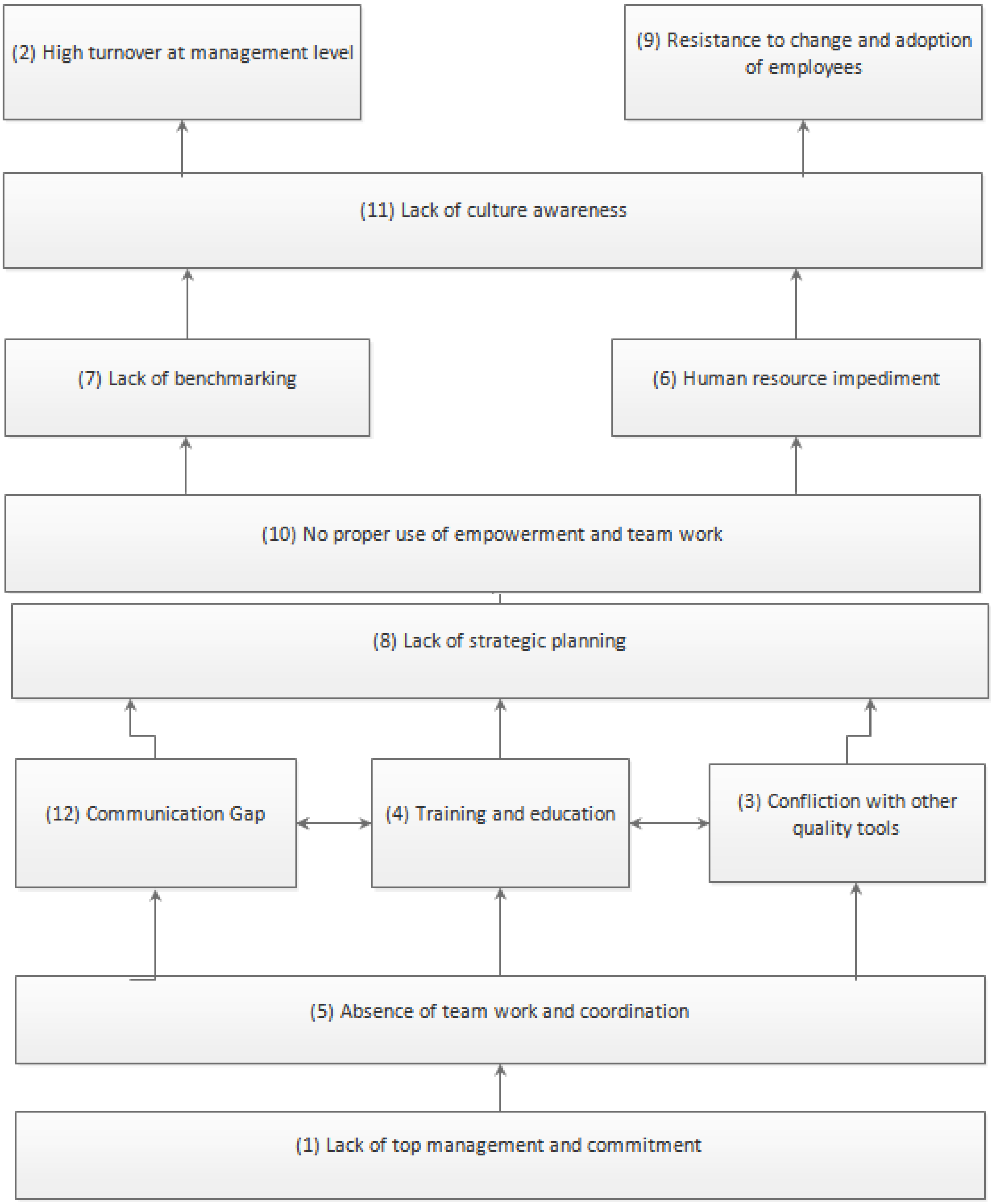
In this section relationship between weak areas is founded. The purpose of this was to find out that which area should be improved first so that it will automatically improves other. For this, "as-is" and "to-be" model was developed.

Table 5. 6: Final reachability matrix with leveling

	1	2	3	4	5	6	7	8	9	10	11	12	deriving power	level
1	1	1	1	1	1	1	1	1	1	1	1	1	12	I
2	0	1	0	0	0	0	0	0	0	0	0	0	1	VIII
3	0	1	1	1	0	1	1*	1	1	1	1	1	10	III
4	0	1	1	1	0	1*	1	1	1	1	1	1	10	III
5	0	1	1	1	1	1	1	1	1	1	1	1	11	II
6	0	1*	0	0	0	1	0	0	1	0	1	0	4	VI
7	0	1	0	0	0	0	1	0	1*	0	1	0	4	VI
8	0	1	0	0	0	1	1	1	1	1	1	0	7	IV
9	0	0	0	0	0	0	0	0	1	0	0	0	1	VIII
10	0	1	0	0	0	1	1	0	1	1	1	0	6	V
11	0	1	0	0	0	0	0	0	1	0	1	0	3	VII
12	0	1	1*	1	0	1*	1	1	1*	1	1	1	10	III
dependence power	1	11	5	5	2	8	8	6	11	7	10	5		

TO-BE model is also developing by the original information provided by the experts and academia. but there some procedure for removing of possible errors. As shown in table the color cell is showing the errors present in the original data. These errors are removed by doing the procedure of transitivity done in excel software and other analysis MICMAC is applied. And then a conical matric is formed which showing the number of levels and deriving power for developing the diagraph. Diagraph is converted into ISM model which show the framework for the implementation of lean strategies. To be model is having eight levels and the levels are classified as shown in previous chapter 4.

A final framework for the implementation of lean strategies and lean tools are developed whichoffers a variety of advantages like:



This model explains that first of all "Lack of top management and commitment" is to be improved; it will improve absence of team work and coordination. Improvement in absence of team work will automatically improves communication gap, training & education and confliction with other quality tools, this will automatically improve lack of strategy planning and this will improve no proper use of empowerment and team work. This will improve two factors; Human resource imp ident and lack of benchmarking. Cultural awareness will be improved by previous two factors. High turnover at management level and adoption of employees will be improved by improving cultural awareness. Similar cycle will be repeated for further improvement.

After assigning the project in Hydraulic Press and Forge Shop, we visited the shops in detail and analyzed every object and equipment ergonomically. The hurdles during the implementation of 5s were as under below

1. Items/tooling's of xyz were there on which we cannot apply 5s.
2. Equipment/tooling's that are property of HMC but unfortunately out dated/non-functional could not be discarded.
3. Finished goods related to other shops could not be shifted to the concerned due to senior officer's decision.
4. Products related to clients (KRL, PSM and HIT) could not be discarded as well.

During first visit we also observed that there are so many improvements which could be made through 5s. We have also examined that there were so many items that needed to be in their correct place as we have studied in 5s. Keeping above hurdles in view, motivationally we have started our work.

Table 5. 7: Showing before and after images of 5's

Before	**After**
	
In-Front of entrance of HPS right side before implementation of 5S	In-Front of entrance of HPS right side after implementation of 5S.
	

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In-Front of entrance of HPS left side before implementation of 5S	In-Front of entrance of HPS left side After implementation of 5S
	
Area adjacent to furnace A4-8 before the implementation of 5S	Area adjacent to furnace A4-8 After the implementation of 5S
	
area adjacent to furnace A4-8 before the implementation of 5S.	area adjacent to furnace A4-8 after the implementation of 5S.

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Surface plate before implementation of 5s.	Surface plate After implementation of 5s.

Results of 6S implementation
Increases in productivity
- Reduces lead times thereby improving product delivery time.
- Reduces equipment downtime, maintenance and cycle time.
- Improves daily and shift startup times and reduces changeover time.
- Reduces the amount of time wasted searching for tools and equipment.

Increases in quality
- Improves quality by reducing the amount of errors/defects.
- Implements standardization thereby achieving output consistency.
- The pleasantries of the simplified work environment increases employee morale.

Reduction in cost
- Provides cost-savings by reducing inventory, storage fees and space requirements.
- Improves safety thereby reducing the cost of worker injuries.
- Reduces the amount of scrap thereby reducing production cost.

The system as a whole minimizes waste and improves efficiency by ensuring that workers are spending time doing productive task rather than looking for misplaced tools, sorting unnecessary through stacks of waste material or rearranging the work environment at the change of shifts.

One of the great aspects of implementing a 5s system is that it can be done today and everyone can participate. Furthermore, all businesses and all departments can benefit from the 5s system. Manufacturing and industrial plants have the greatest applications; however, its use is not limited to production areas. Office and administration areas, information or data flow hubs, retail space and service delivery systems can also achieve productivity gains from its implementation. The bottom line advantage to any company is an increase in profits and a maximization of shareholder wealth.

IV. DISCUSSION

In 1st phase of our project "Lean assessment of manufacturing setup" we have done lean assessment of 10 industries on the bases of questionnaire developed on focusing three major areas; people management, system management and technology management. For this purpose, we used LESAT (lean Enterprise Self-Assessment tool). From survey we collected data and separated weak areas where there was no or less lean implementation and strong areas where lean implementation was satisfied. After that to find relationship between weak areas ISM (Interpretive Structure Modeling) and MICMAC analysis is applied. From this "to be model" is developed. In 2nd phase of project we have selected hydraulic press shop and applied 5S (a lean tool) and made improvements regarding material handling, cost and time etc.

Applications of lean manufacturing have been less common in the process sector, in part because of a perception that this sector is less amenable to many lean techniques, and in part because of the lack of documented applications, this has caused managers to be reluctant to commit to the improvement program

V. FUTURE RECOMMENDATIONS

There is no training center in the industry due to this, employees are not getting proper training and hence ratio of defective parts is high. That is why training center should must be developed to overcome this loss. ISM technique is a very effective for the implementation of lean strategies, because it provides influence of each factor with other, which easily remove the errors but in case of AHP and fishbone Diagram there we reach only at critical cause but don't know how to remove this. So for implementation of lean tools or strategies ISM technique should be use.

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