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Studying the Relationship Between ERP and the Performance of Lean Production in "Iran Khodro Industrial Group"

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ABSTRACT

What is known as controlling a system is related to the variables of planning properly, an approach toward development, making appropriate decisions within changing conditions, satisfying and maintaining dignity of all stakeholders and achieving an excellent and lean level.

Formulating a pure strategy toward detecting and removing the sources of dissipation aims to minimize the costs and make the organization move toward proficiency and organizational excellence. The above definitions are representative of the degree of similarity and existence of a relation between the ERP and Lean Production objectives. The present study aims to introduce these systems, their goals and their potential synergistic. Therefore, the purpose of the research is detecting the impacts of ERP system on lean manufacturing system in IRAN KHODRO Industry Group. The research also had some minor purposes such as detecting those lean manufacturing techniques affected by ERP modules.

In this regard, after detecting the lean production tools in company and considering the details of ERP modules in company, we defined the research questions for experts, results were determined using SPSS software and at the end, According to confirming six hypotheses out of 10, the existence of a relation between these two systems was confirmed.

Keywords: *Information Systems, Enterprise Resource Planning(ERP), Lean Production,IKco*

1. Introduction

In recent years, many Iranian organizations have reached to the understanding that it is best to use the most efficient resources in the way of production, due to economical instabilities. Therefore, motivated to create and use flexible approaches, they aim to reach wider market shares and better customer satisfaction.

Iran Khodro Industrial Group (IKCO) is an example of such. As a car manufacturing company, it has pursued using industrial information systems such as enterprise resource planning and production, as well as establishing integrated systems of production regarding better efficiency, better customer satisfaction and lower prices, in order to achieve that goals(*www.**ikco**.ir/En/)*.

While IKCO was able to design and execute ERP systems throughout the organization with exemplary dedication of time and funds, studies show that as technology grows in the field of Information Technology, there could be a positive correlation between ERP information system and lean manufacturing; meaning ERP could result in better and faster achieving lean manufacturing.

In order to deal with changing external environment and overcome the limitations of legacy systems, many companies have implemented Enterprise Resource Planning (ERP) systems. Unlike 'function oriented' systems that support only specific business activities, but ERP systems are intended to integrate company-wide processes such as financial, sourcing, planning, human resources, erc. by adopting good reference models from efficient firms. In addition, according to these issues it can make the state of affairs ready for progress (Wright, 2002).

In recent decades, experts have tried to converge their ideas on production; development and utilization of mechanisms that could help organizations improve the quality, maximize the utilization and lower the prices of products. In order to achieve success, converting to lean production seems crucial and inevitable, experts say (McDuffie, 1995). The focus of this system is on efficiency; reducing or removing wastage of resources. According to its approach, any item of production items, such as resources, human resources, production space, tools, machinery and progress time which consume more than minimum required amount, are considered wastage and need to be removed and omitted(Bichno, 2009&Shingo, 1981). As a result of using lean production method, many successful companies have achieved noticeable advances, thus, by using the experience, tried and extended the method over other parts of production, such as design, order and input, delivery, payment methods (Brown and Mefford, 2004)

Many researches are already done to study the execution of IT and industrial systems on practical fields. In this study, therefore, we try to focus on synergy efficiency of these organizational systems on each other.

Iran Khodro as an international car manufacturing company (IKCO) has been Doing a considerable amount of research on lean production by experts and considering its revealed benefits, this company has been using and executing this system on all areas of the production. In this study, therefore, we aimed to identify organizational lean production techniques "Standardization of Processes, Value Stream Mapping, Continuous Flow, Point-of-use(Sourcing), 5S, Total Productive Maintenance, Production Level, Quality at the Source, Cellular Manufacturing, Kanban, Kaizen and Set-up Reduction"(Hines, 2010) which can take effect from ERP system with its fundamental modules (Sales and distribution, Financial, Production Planning, Human Resources and Materials Management(Madapusi & Souza2012). In other words, we try to identify the effect of ERP system on lean production and subsequently, recognition the effect of ERP on which techniques of lean production.

2. Literature

In 1970s, IT has developed into production industry. With the growth of information systems, MPR system was created in the field of resource classification. Subsequently, MRPII systems were created. In 1990s, ERP systems were made to overcome lack of integration through the systems. ERP is a integrated-based software that can run various processes for business such as scheduling, production, resource management and customer service(McGaughley & Gunasekaran, 2007). While information systems developed, many studies were done regarding capability, validity and quality of execution; causes of failure, success, efficiency etc. which are disregarded from further explanations, due to the aim of the study.

Lean production was born in 1960 in Japan. It was only an idea that undermined and criticized older approaches, calling them deficit. Taiichi Ohno discovered the limitations of mass production after visiting Ford car-manufacturing company in Detroit, and published the book "*Toyota production system",* introducing lean production method (Ohno, 1988). In 1990s, a study was published with the title of *"The Machine That Changed the World"* by James Womack and his colleagues. They regarded the lean production system as a combination of Ford's traditional systems and sociotechnical systems of Japanese environment(Biazzo & Panizzolo, 2000). Therefore, lean production is integrated with other car-production approaches. Afterwards, studies have been done to identify Theoretical and Practical framework of this method on all of its aspects (Peterson, 2009).

Theoretically speaking, studies discover concepts, which result in a better understanding of lean philosophy and targets. They are called "Performance Factors" (Spear and Bowne, 1999).

Practically speaking, studies discover ways to execute lean production system in real life. They are called "Determining Factors" that are done to review the executive guidelines and necessary changes needed to reach optimum performance (Shah and Ward, 2003).

According to subject of this research and absence of research about this important filed, we have intended to discover the combined potential of the two approaches, we tried to review the in-progress lean production techniques, considering ERP modules used in IKCO, and reach the result of lean improvement, as well as introducing some aspects of lean production that are better affected by ERP system.

There are not specific related studies to discover the combined potential of ERP system and lean production simultaneously, but recently Powell and his colleagues have been working on ERP-based lean implementation process in Noca-electronics manufacturing and service supplier company with a scientific approach over a year (Powell and etc. 2013). This is while before that Daryl Powell and his colleague had been researching on possibility of simultaneous combined potential of ERP and lean production (Powell and Strand, 2011).

Many software developing companies such as Oracle, Infor, Pelion, SAP, Epicor, etc. have advertising a great amount on comparing ERP and lean production systems. As a result of all the efforts, producers were advised to use the combination of ERP and lean production systems together.

Software	Vendor	Website
Demand Point	Pelion Systems	www.pelionsystems.com
E2	Shoptech	www.shoptech.com
Fourth Shift	Softbrands Manufacturing Solution	www.fourthshift.com
IFS Applications IFS	IFS	www.ifsworld.com
Infor ERP VISUAL	Infor Global Solutions, Inc.	www.infor.com
Made2Manage	Consona	www.made2manage.com
MFG/PRO	QAD	www.qad.com
Oracle E –Business Suite	Oracle	www.oracle.com
Vista	Epicor	www.epicor.com
WinMan	TTW	www.winmanusa.com
xApp	SAP	www.sap.com

Lean-Enabled Software (table 1-1)

3. Research methodology

Observing and recording the phenomena is the primary feature of the present study. Since this study aims to reduce the costs and improve the lean manufacturing function in IRANKHODRO Company, the researcher has chosen *Observational* research method. Due to the fact that this study is concerned with assessing the relation between ERP system and the process of lean manufacturing, the type of the research is *delineation*. Regarding Data collection, we can say that

since the required data are extracted from the documentaries of the organization or are the tacit knowledge of some personnel, so the method applied for this process is Gauging.

3.1. Data collection method

Two general approaches were applied for collecting the required data:

1- Library method: referring to organizational documents, articles, books, digital texts etc.

2- Enquiry method (questionnaire and interview): in order to collect the data required for analysis, questionnaires were distributed among some personnel (managers and experts) who possess a tacit knowledge regarding the research question.

3.2. Population and sample

The statistical population for this research was consisted of 22 experts who were in different positions such as the assistant and the deputy of the project, the head module users and all the other specialists. The small sample size of the research is due to the fact that the sample was equal with the population.

3.3. Data collection tools

The required data are collected thorough referring to organization archives only in the cases that organizational data are applicable. Meanwhile questionnaires and interviews are used in the cases that the required data are gathered only through asking questions from experts who possess a tacit knowledge relevant to the research question. These questionnaires are designed by the researcher. Designing questionnaires was conducted applying the five-option spectrum of Likert that is one of the most frequently used measuring scales(table 1-3). The general form and scoring scale of this spectrum are represented in figure 1-3 and this questionnaire is available in the appendix as well.

N/A	Poor	Fair	Medium	High	Strongly	Question	Q. Number
	1	2	3	4	5	...	...

Likert scale(table1-3)

3.4. Conceptual research model & Hypotheses

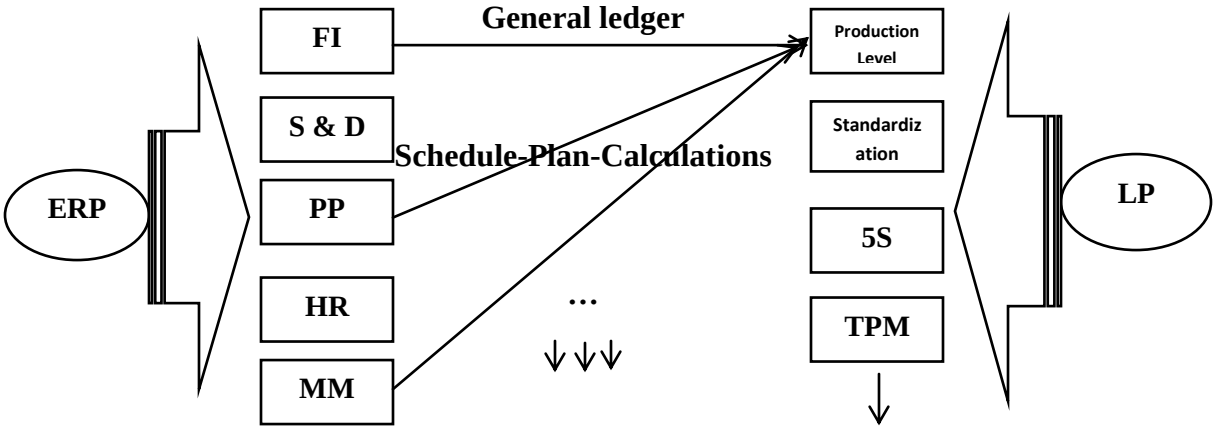

Figure (1-3) conceptual model research (Detailed)

Step 1: modules associated with lean manufacturing techniques were determined after referring to scientific resources, reviewing documentaries related to ERP system of the company and consulting with experts.(for example: FI&PP&MM with their Sub Modules effect on Production Level of Lean Production)

Step 2: inquiring from ERP experts and lean-making experts

H0. There is a relation between ERP system and the function of lean manufacturing in IRAN KHODRO Company.

H1. There is a relation between ERP system and Standardization of process.

H2. There is a relation between ERP system and Value Stream Mapping.

H3. There is a relation between ERP system and Set up Tools.

H4. There is a relation between ERP system and Production Level.

H5. There is a relation between ERP system and 5S.

H6. There is a relation between ERP system and TPM.

H7. There is a relation between ERP system and Kanban.

H8. There is a relation between ERP system and Cellular Output.

H9. There is a relation between ERP system and Quality at the Source.

H10. There is a relation between ERP system and Point of use(Sourcing).

3.5. Reliability and validity

Validity is the extent to which a test measures what it is supposed to measure. The question of validity is raised in the context of the three points made above, the form of the test, the purpose of the test and the population for whom it is intended. Also Research requires dependable measurement. (Nunnally) Measurements are reliable to the extent that they are repeatable and that any random influence which tends to make measurements different from occasion to occasion or circumstance to circumstance is a source of measurement error(Berk, 1990).

Cronbach coefficient is one of the methods devised to calculate the reliability feature. Regarding survey research serving as the main tool for questionnaire data, this method proves the best. Cronbach coefficient results represent the degree of internal consistency existing among measuring tools such as questionnaires (Cronbach, 1990).

Reliability Statistics

Cronbach's Alpha	N of Items
.907	50

Using SPSS software the value of this coefficient was calculated for the questionnaire and The result was 0.907.

3.6. Data analysis

Parametric statistics was applied for analyzing the data collected. Considering the fact that data distribution appeared normal and with high level of accuracy, therefore parametric analysis including *T-test* can be used in these cases.

4 - Data

Issue	Test Value = 3						Result
					(95%)Confidence Interval of the Defference		
	N	t	Mean	Sig.	Lower	Upper	
ERP- Standardized	22	2.095	3.2492	0.049	0.0018	0.4967	✓
ERP- Value Stream map	22	-0.909	2.9174	0.374	-0.2715	0.1063	❖
ERP- Set up tools	22	1.227	3.1720	0.009	-0.1195	0.4634	✓
ERP- Production level	22	4.539	3.4902	0.018	0.2656	0.7147	✓
ERP- 5s	22	1.513	2.6879	0.045	-0.0724	0.4588	❖
ERP- TPM	22	0.873	2.8742	0.393	-0.4254	0.1739	❖
ERP- Kanban	22	-3.658	2.7447	0.001	-0.4005	-0.1101	❖
ERP- Cellular Output	22	-0.705	3.2091	0.028	-0.3589	0.1771	✓
ERP- Quality at the source	22	3.407	3.4106	0.003	0.1600	0.6612	✓
ERP- Point of use (Sourcing)	22	3.362	3.3659	0.003	0.1396	0.5922	✓

Detailed Data (table 4-1)

The above-mentioned data represent the results of assessing the existence of a relation between ERP system and lean manufacturing. In the following test, ERP system is comprised of the modules including "Financial, Production Planning, Human resources, Material Management, Sales and Distribution". The test has attempted to assess the relation between the ERP system and the techniques regarding the value of relevant average. The criterion for the average and for the value of sig is respectively 3 and 5%. Thus with the confidence level of 0.95, it can be claimed that the significant answer is positive or in other words variables have an impact upon one another.

5. Conclusion: The results of hypothesis testing (ERP-lean manufacturing)

Considering the nature of the subject, the major hypothesis cannot result in an absolute response. However, since among 10 sub-hypothesis six of them have been confirmed including: Standardization of Process(H1), Set-up Reduction(H3), Production Level(H4), Cellular Manufacturing(H8), Quality at the Source(H9) and Point-of-use(H10). It can be concluded that ERP considerably affects lean manufacturing implementation at least through the six mentioned techniques.

If we consider the standard values as the feasibility boundary for the best possible way of conducting affairs, then it is acceptable that a decent success rate can be achieved through integrating and monitoring data. Production level can be also determined through applying the output of such information gathering system.

Quality at the source is a variable which is capable of affecting reinventing, cost imposing and ultimate quality of the product. This relation can be observed through taking the functions of ERP modules into account. Regarding production circulation, the required value of Point-of-use which means inventory level and consumption date is of great significance. Set-up Reduction is another tangible impact made by Production Planning module.

Cellular manufacturing has become an integral part of lean manufacturing systems. Cellular manufacturing is based on the principles of group technology, which seeks to take full advantage of the similarity between parts, through standardization and common processing, which is so important for Iran KHODRO industry, so it easily can make sense that how ERP works on this technique.

5.1. Further suggestions

Research suggestions were offered based on the results of hypothesis testing. Assessing the relation between the following ERP modules is of the future research priorities. These modules are:

Financials**,** Production Planning**,** Human Resources**,** Materials Management**,** Sales and Distribution With Standardization of Processes, Value Stream Mapping, Continuous Flow, Point-of-use (Sourcing). Standardization of Processes: Total Productive Maintenance, Production Level, Quality at the Source, Cellular Manufacturing, Kanban, Kaizen and Set-up Reduction.

The selection of these modules should be in correspondence with production condition changes.

A long-term investigation period along with continuous techniques monitoring in ERP system would result in researches that are more accurate.

Apart from detecting the relations, the second research goal is to apply those lean manufacturing techniques asynchronously.

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