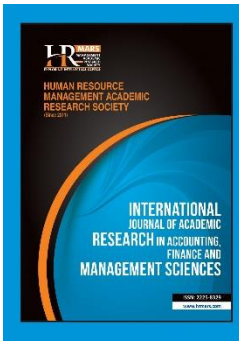

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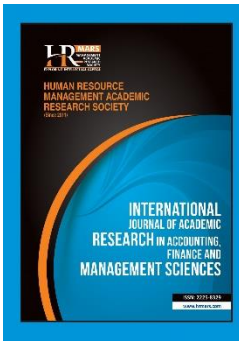
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Performing Lean Manufacturing System in Small and Medium Enterprises

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Abstract
This paper presents a conceptual framework to implement techniques for performing lean in the high-variety low volume (HVLV) environment. Lean production executed as a possible solution for many organizations. Anyhow the lean formula is appropriate directly only to the Build to stock business, but the customized product environment has to conform lean manufacturing principle. This paper has a two-phrase quantitative framework to convert small and medium enterprises (SMEs) to be lean. Phrase 1 has three interrelated parts: (1) redesigning an organization by using the power of computer Simulation integrated with business procedure. (2) Value stream mapping (VSM) is used to produce a map of both value and unused in a given procedure. This tool has also a main disadvantage for Small manufacturing ability because many value streams are made-up of hundreds of industrial parts and products. (3) Integrative supplier relationship is one of the most critical factors to sustain an advantage in the increasing levels of competition. Phrase 2 performs a just in time production scheme by using ant colony optimization technique combines with a Simulation tool. This paper addresses how to combine lean thought with Simulation optimization, the step of this framework to obtain the optimization solution.
Keywords: Small and Medium Enterprises (SMEs), Lean Manufacturing, Workshop Environment

Introduction

Lean is based on knowledge gained through study from Toyota who increased market share by improving their procedures, especially on the workshop, as well as in formulate and development (Parry et al., 2010). The general thought of behind lean manufacturing is to reduce unused and the lead time. Unused is that of human activity which takes in resources but produces no value. Therefore, time is one of these unused. An advantage of reduced lead time is that it improves customer feedback and takes into consideration the producer as soon as address quality issues and

interests. A decreased lead time reduces the time it takes a company to satisfy the customers' changing needs and wants. Lean production has increasingly being executed as a possible solution for many organizations. Shah & Ward, (2007) defined lean production as an integrated socio-technical system whose main objective is to remove by simultaneously reducing or minimizing supplier, customer, and internal variability. The performance of lean production practices improve productivity through reduced lead times, material and staff costs, increased quality etc. However, the lean formula is appropriate directly only to the Build to stock business, but the customized product environment as Small manufacturing has to conform lean manufacturing principle (Chitturi et al., 2007). The key problem covering the high variety, low volume (HVLV) organization is that it has a chaos manufacturing system than the characteristic lean manufacturing. One of chaos factors can be recognized as scheme (Jina et al., 1997). Small manufacturing production is characteristic of many SMEs within the customized sector. Also, small manufacturing planning can be useable to the manufacture procedure and effect the production time, the cost of production and on-time delivery for a plant. Although lean manufacturing is becoming an accepted technique for productivity improvement, SMEs are still not certain of tangible and intangible advantages they may obtain. This paper suggests a conceptual framework to develop an appropriate lean manufacturing system for SMEs. Panizzolo, (1998) examined the interviews of 27 lean manufacturers and accomplished with the aim of comprehending the scope to which the various improvement scheme or best practices were useable in the companies. Taj, (2008) also examined the structure of lean production and estimated its present state of practice in selected plants from 65 participants in China. In order to accomplish the goals of lean manufacturing many tools have developed. One of the key lean tools is that of "Value Stream Mapping (VSM)". This tool when used to produce a map of both value and unused in a given procedure. Anyhow, VSM has also a main disadvantage for small manufacturing ability because many value streams are made-up of hundreds of industrial parts and products. Thus, this complication cannot be addressed with the standard method (Braglia et al., 2006). From this reason, the traditional VSM method was found unsatisfactory for mapping such a flow network. The business Procedural programming has produced a quickly growing number of methodologies, and modeling techniques and tools to support it. To select the right technique and the right tool is important to develop the business modeling. The modeler must know and recognize the goal of the model to be assembled (Phalp, 1998). Presently, the power of computer software plays a necessary role for business procedure management. Van der Aalst et al., (2003) defined business procedure management as supporting business procedures using methods, techniques, and software to design, perform, control, and analyze operational procedures involving humans, organizations, implementations, documents and other sources of information. Business procedure redesigning and combine with Simulation techniques for electronics product (Berry et al., 1995). They also suggest that business procedure redesigning supporters the drive to minimizing total costs while maximizing customer service levels. Simulation modeling is a common ideal for analyzing complex systems. Ruohonen & Jokitalo, (2008) suggest that useable simulation is improving the operation in the metal industry, such as the quality of service and productivity of the operation. Greasley, (2008) estimated the size of storage areas demanded for a suggested textile manufacturing ability. Therefore, Simulation is one of the most useful tools which can integrate with other techniques such as business procedure, operation research etc. One of the popular techniques to deal with inaccuracy in supplier choice is Multiple-criteria decision making (MCDM) which divided into multi-objective decision-making (MODM) and multi-attribute decision-making (MADM). Most of the MADM methods require

that each characteristic is given a weight or relative consequence with respect to their impact on the decision problem being solved. The powerful global competition forces manufacturers, who seek to reply their customers with high quality products in the right time at the right place (Abdel-Malek et al., 2005). Therefore the selection of strategic partners that will provide them with the necessary products, parts, and materials in a timely and effective mode to competitive advantage is challenge (Sarkis & Talluri, 2002). When the mathematical model of a system is studied using Simulation, it is called a Simulation model. The procedure of result the best input variable values from among all possibilities without clearly evaluating each possibility is Simulation optimization (Carson & Maria, 1997). Eskandari et al., (2005) presented improved Simulation optimization problems. This approach integrated stochastic no domination-based multi-objective maximum production technique with a Simulation model and genetic algorithms. Mejtsky, (2008) presented an improved sweep metaheuristic for separate event Simulation optimization. The basic idea is to run a limited number of fractional solutions in parallel and to search for solutions by searching the fractional solutions. The small manufacturing planning problem is measured to be a good representation of the general field and has become popular for being notoriously hard to solve. It is probably the most studied and well developed model in deterministic planning theory, serving as a comparative test-bed for different solution techniques, old and new and as it is also strongly motivated by practical necessity's it is clearly worth comprehending (Jain & Meeran, 1998). Van Laarhoven et al (1992) examined the possible of simulated annealing algorithm for the problem of result the minimum make span in a small manufacturing . Their algorithm was better than two estimated approaches, but it absorbed large running time. The first combination optimization problem which was solved by ACO is the travelling salesman problem (TSP). Dorigo & Gambardella, (1997) illustrated the thought of a simulated ant colony to solve this problem. The ACO is recognized an appropriate representation for the problem and an appropriate heuristic that illustrates the distance between any two nodes of the graph. Then, the probabilistic interaction among the simulated ants re-conciliated by the pheromone path deposited on the graph edges. In ACO algorithms simulated ants are stochastic useful procedures that build solutions by moving on the construction graph $G_C = (C, L)$, where the set L completely links the components C. The problem restrictions $\Omega(t)$ are built into the ants' useful heuristic. In most implementations, ants construct achievable solutions. However, sometimes it may be necessary or beneficial to also let them construct in achievable solutions. Component $c_i \in C$ and connections $l_{ij} \in L$ can have related a *pheromone path* τ (τ_i if related with components, τ_{ij} if related with connections), and a *heuristic value* η (η_i and η_{ij}, respectively). The pheromone path encodes a long-term memory about the entire ant search procedure, and is modernize by the ants themselves. Otherwise, the heuristic value, often called *heuristic information*, represents a priori information about the problem illustration or run-time information provided by a source different from the ants.

Methodology of Research

The above theories are showing that unsatisfactory in integrating the thought of lean for performing in SMEs as small manufacturing environments. The research study aims to extend the comprehending of the roles of lean thought for SMEs. A general survey of the suggested system is shown in Figure 1 which includes of 2 phrases, which are described below.

Phrase 1: A LET (lean Enterprise Transformation) project

The Let project surrounds of business procedure management, value stream management (VSM) and supplies selection. According to our knowledge, we found that information technology (IT) is a necessary tool for serious competing in business world. But, this tool is also too expensive for SMEs, to investment. Therefore, we developed the Let project as a fundamental to be lean for SMEs. In this research we use the IDEFO model; IDEF0 models comprise of a hierarchy of related diagrams. According to each diagram which are on a diagonal row of boxes linked by a network of arrows.

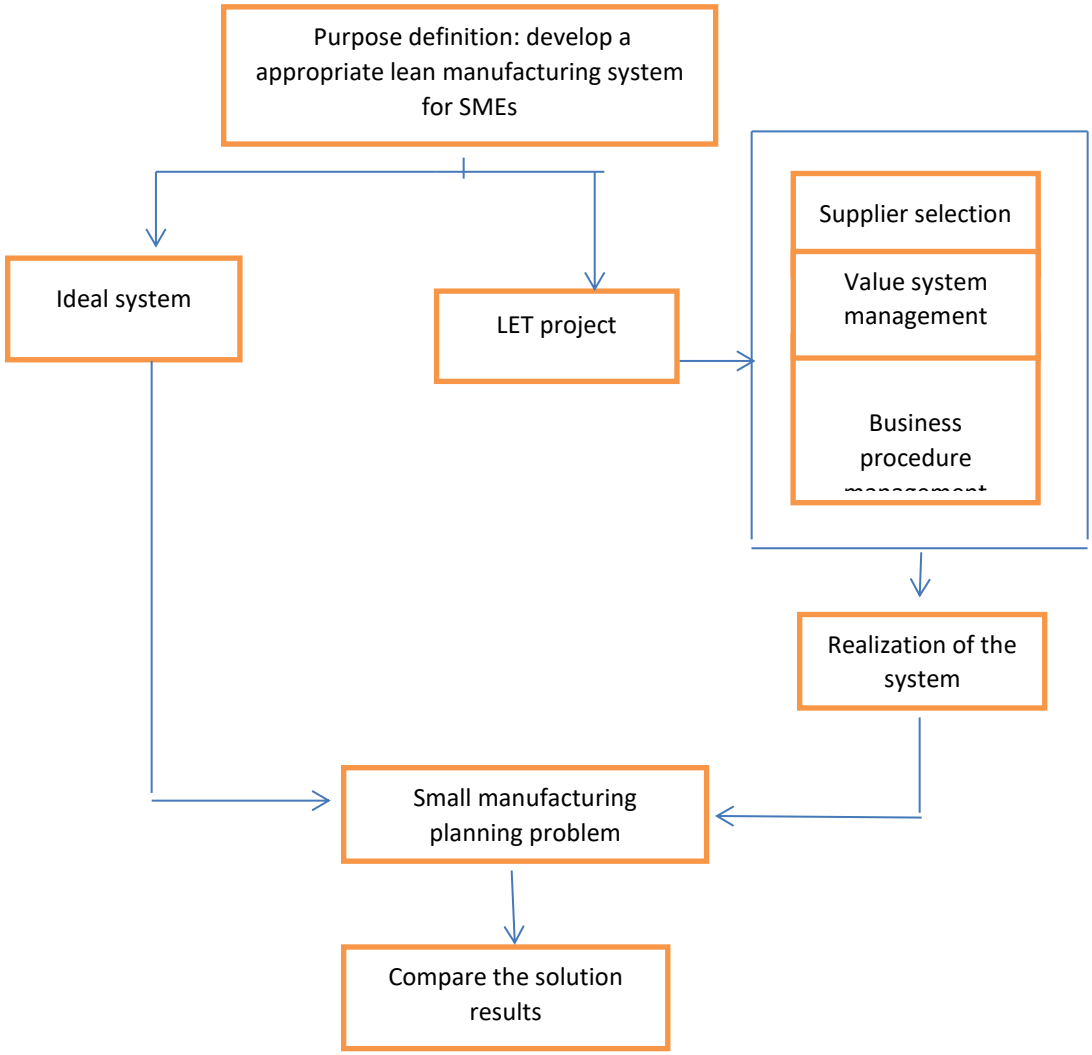

Figure 1. A schematic diagram of the proposed procedure

The boxes described activities which are included within the box. Arrows shows the relationship between activities in terms of the information or objects used demanded by activities (Colquhoun et al., 1993) (Figure 2).

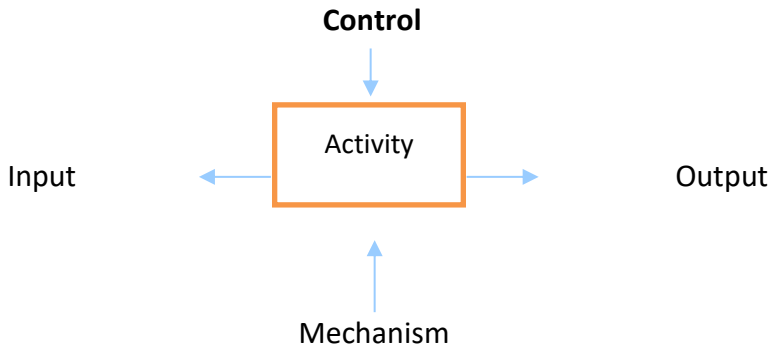

Figure 2. The activity box

Each diagram is indicated by its 'node number' that explains where it lies in the hierarchy of a model as clarifies in Figure 3.

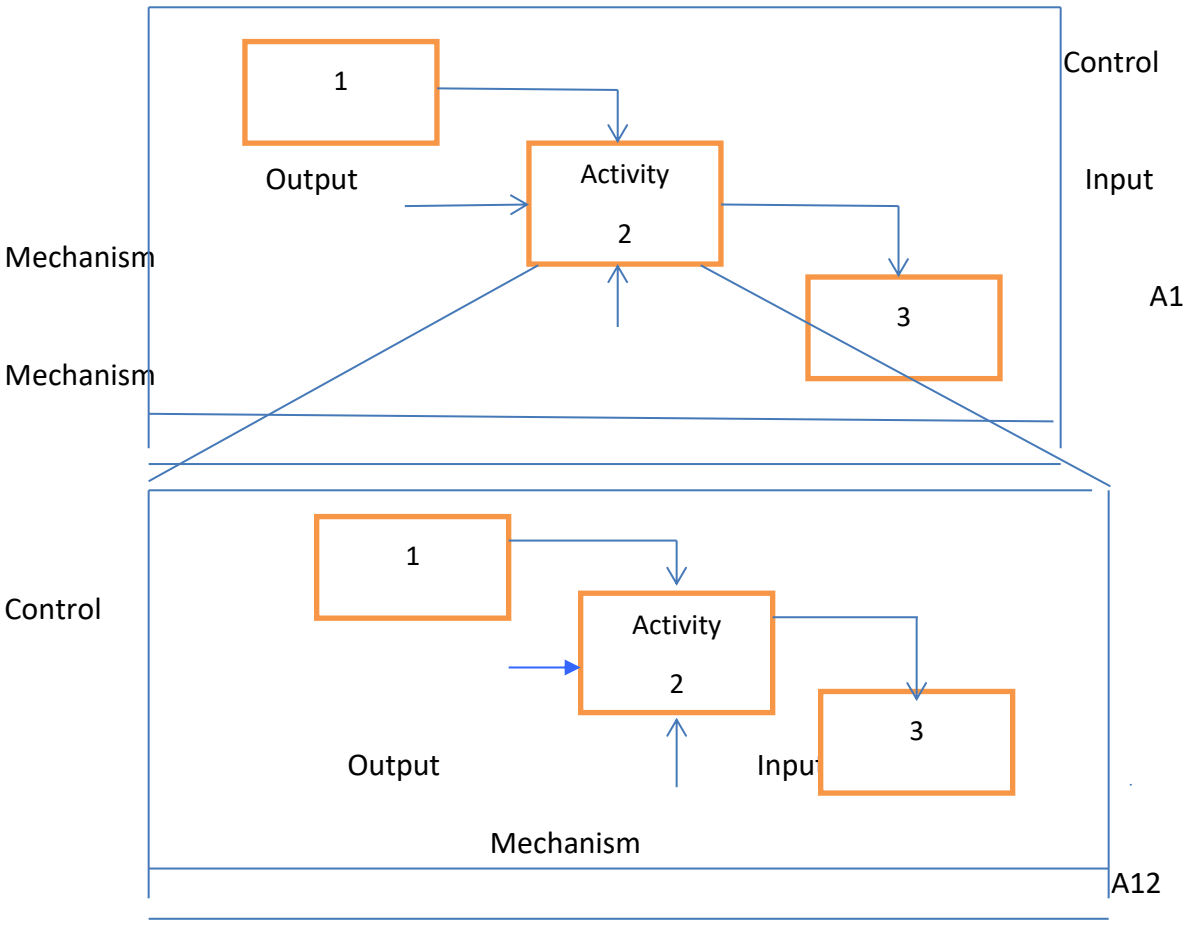

Figure 3. The hierarchy of IDEF0

ACO and simulation optimization for the small manufacture planning problem

In the phrase we implements 8 steps to value stream management which is a procedure for planning and linking lean enterprise through systematic data catching and analysis (Tapping et al.,

2002). Anyhow, for step 4 and 6, in small manufacturing environment cannot use the standard value stream map because the small manufacturing produce a variety of products does not necessarily produce the same products again, and the lead times to produce the products are short, perhaps within a day. Therefore, to stream line the value flow new value stream map has to be attracted for each new order (Alves et al., 2005). As previously mentioned, this research implements a suggested approach is called a new value stream mapping approach for complex production systems. This was done by integrating the standard VSM approach with a set of additional tools extracted from the manufacturing engineering area (Braglia et al., 2006). Especially, the framework is structured to investigate the various branches of the whole value stream only if necessary and following an improve efficiency order. The procedure to select supplier by using MCDM technique is divided into the following parts:

Part 1: Fuzzy Analytic Hierarchy procedure

AHP is a multiple criteria decision-making tool, which was founded by Saaty. This is an Eigen value approach to make personal comparisons for each pair of characteristic or options using a ratio scale. In order to defeat the deficiencies, the fuzzy logic principle was introduced into the AHP for MCDM (Cheng & Mon, 1994). This makes it possible to adopt the AHP in an environment where the input information or the relations between criteria and options are doubtful or inexact.

Part 2: Analytic Hierarchy procedure: A Stochastic Approach

In the AHP, An uncertain manner is generated through a hierarchy resulting in the doubtful values for the global AHP weights of decision options. It was clear that, this doubtfully related with personal judgmental errors which may affect the rank order of decision options and therefore reduce the decision maker's certainty in the obtained results of the AHP (Eskandari & Rabelo, 2007). Wanitwattanakosol et al., (2009, 2010) spanned the differences of fuzzy AHP and stochastic approach to find a best option of freight logistics hub as well as improved this approach by using data mining to select only significant criteria in order to reduce cost from collection data procedure. The small manufacturing planning problem is still a NP-hard and difficult to solve in practice. This research suggests a metaheuristic approach, namely an ant colony optimization (ACO) approach, to stop this problem. Therefore, for the one hand, this research implements ACO for ideal system. For the other hand, accomplishment of the system is implemented by Simulation optimization which include of ACO and Simulation technique. The results from ideal and accomplishment situation are compared. In ideal system is supposed that the procedure of business is flow and stable. But in accomplishment system, stochastic event always happen in the system. LET project is used to convert accomplishment to be closeness ideal system.

Conclusions

The dramatic performance improvements available by following lean thought such as low unused principles are well-founded in high volume, comparatively low variety situations. But the customized product environment as small manufacturing has to make appropriate lean manufacturing principle. Most companies must carefully determine which lean practices they can use without delay and which need to be conformed to meet their special circumstances. The authors consider that the framework presented in this paper provides a structure for adjustment to be lean

for SMEs. In future, the further research in each step of a framework by incorporated it with some data to see the real effect should be done.

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