Product Development in Agile Manufacturing

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***Abstract*— With the rapidly intensifying market competition, shortening product lifecycles and increased customer demands, industrialists worldwide are developing newer production methodologies and business strategies to remain in competition. Lean and agile are the business strategies gaining preference these days. Normally, these strategies concentrate on various activities occurring inside and outside of the enterprise. Up gradation from traditional manufacturing to agile manufacturing is generally a systematic process and involves identifying the factors which make enterprise or rather we say the business agile. As we know, product development is a process of transforming market opportunity into a product available for sale. If the lean and agile philosophy is applied to every step of product development process itself, the existing production systems can be rapidly configured as lean or agile systems especially when the product is in pre-manufacturing i.e. conceptual phase. The present paper applies the agile production strategy to the traditional product development process. It considers the factors intrinsic and extrinsic to the enterprise and highlights their impact on product development process as well as on production resources i.e. people, equipment, procedures needed to develop the product.**

***Keywords* — Agile manufacturing, product development, leagile manufacturing**

I. INTRODUCTION

Shortening product life cycles and increased competitiveness has forced the manufacturers to introduce products rapidly into the market. This demands significantly the agility which is nothing but the ability to prosper in a competitive business environment characterized by constant and unpredictable change. [1] Agile manufacturing philosophy includes the impact of both internal and external factors on working of manufacturing system. Internal factors are the valuable production resources like people, equipment, procedures (strategies) and external factors are mass market fragmentation, virtual enterprise, customer expectation, competition etc. Each of these factors, either internal or external has a great impact on working of agile manufacturing. E.g. the team (people) must have certain attributes like multi functionality, ability to get reconfigured on demand, cooperativeness and competitiveness for becoming an agile team. [1][2] Existing organizations either traditional or integrated are converting to agile manufacturing. Even network manufacturing systems can also be operated in agile way. J.M. Frayret et al [3] presented NetMan approach for this. J. Prince, J.M. Kay [4] showed that Traditional manufacturing plants like those with functional layout can successfully be converted into agile system by Virtual group (VG) and enhanced production flow analysis (EPFA) methodology. According to Goldman et al. (1995), organization must have flexibility to be an agile. This implies that even highly integrated manufacturing systems if not designed for anticipated flexibility, cannot meet the goal. Developing agility is not simple thing. It needs lots of decisions and considerable time duration and study. As agility covers the factors right from product design to marketing, instead of applying agile philosophy to every functional area of manufacturing, if we apply it to every step of product development process itself, the existing production systems can be rapidly configured as agile systems especially when the product is in pre-manufacturing i.e. conceptual phase. The present paper is organized into four sections the second section lists out the major input (parameters) to be considered at every stage of traditional product development process from agile manufacturing point of view. This is better explained in graphical format. The third section gives the simplified view of this exercise by mapping these inputs into appropriate requirements of production system against the stages of product development. Fourth section i.e. the concluding section advocates some of the benefits of this way of working.

II. PRODUCT DEVELOPMENT AND PREDOMINANT AGILE MANUFACTURING FACTORS

Apart from general agile manufacturing factors, some of the factors which are drawing attention and are taken into account by different authors in their recent literature are also considered in this paper for the product development process. Some of which are clearly mentioned here. Nicola Costantino & et al. [6] highlighted the role of Manufacturing supply chain (MSC) in agile manufacturing. They pointed out that an agile MSC network must be integrated and there should be a stream line flow of material, information and money. I.e. a good MSC network helps in achieving agility.

David Z. Zhang [7] in his paper "Towards theory building in agile manufacturing strategies—Case studies of an agility taxonomy" showed that product life cycle duration and maturity of product has significant impact on selection of agility strategy i.e. Quick agility, responsive agility and proactive agility. The planning for retirement of product i.e. last step in product development process (see fig 1) involves many decisions to be taken. The agile strategy chosen definitely affects these decisions. And further helps to choose strategy for new product development (NPD).

Also the Complex production processes, expensive equipments and sophisticated customer requirements demand capacity planning methodologies that promote agile response in a complex production environment. [8] Hence capacity planning decisions for agility must be considered at the stage of process selection. Again one important point covered in this paper is the perfection of product and process. Both lean and agile manufacturing have this strategy common in between them as shown in figure 2. Rajesh Krishnamurthy & Charlene A yauch [9] presented a comparative study between lean and agile manufacturing systems in their paper, 'Leagile Manufacturing: a proposed corporate infrastructure.'

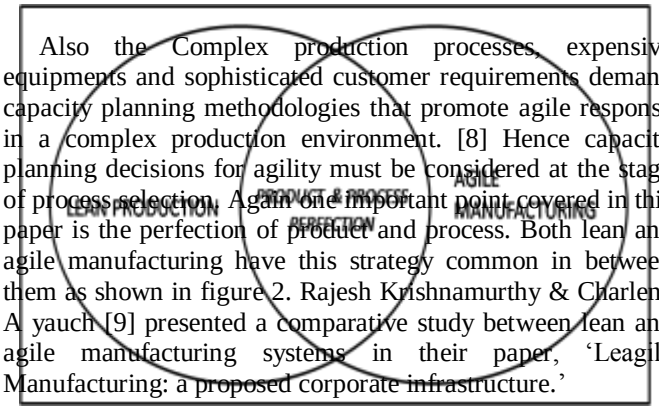

Fig.2 Lean and agile manufacturing overlap

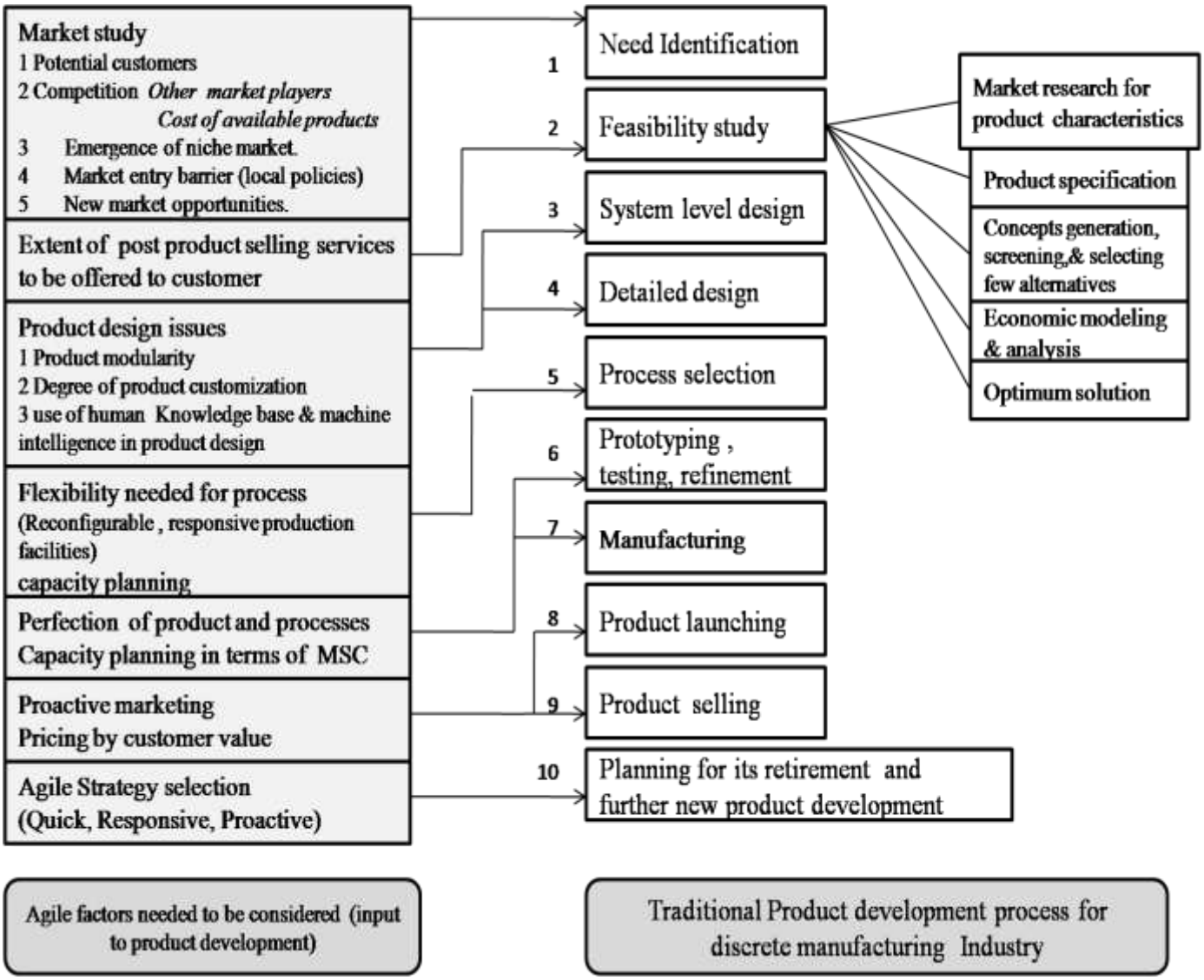

Fig.1 Product development and agile Manufacturing

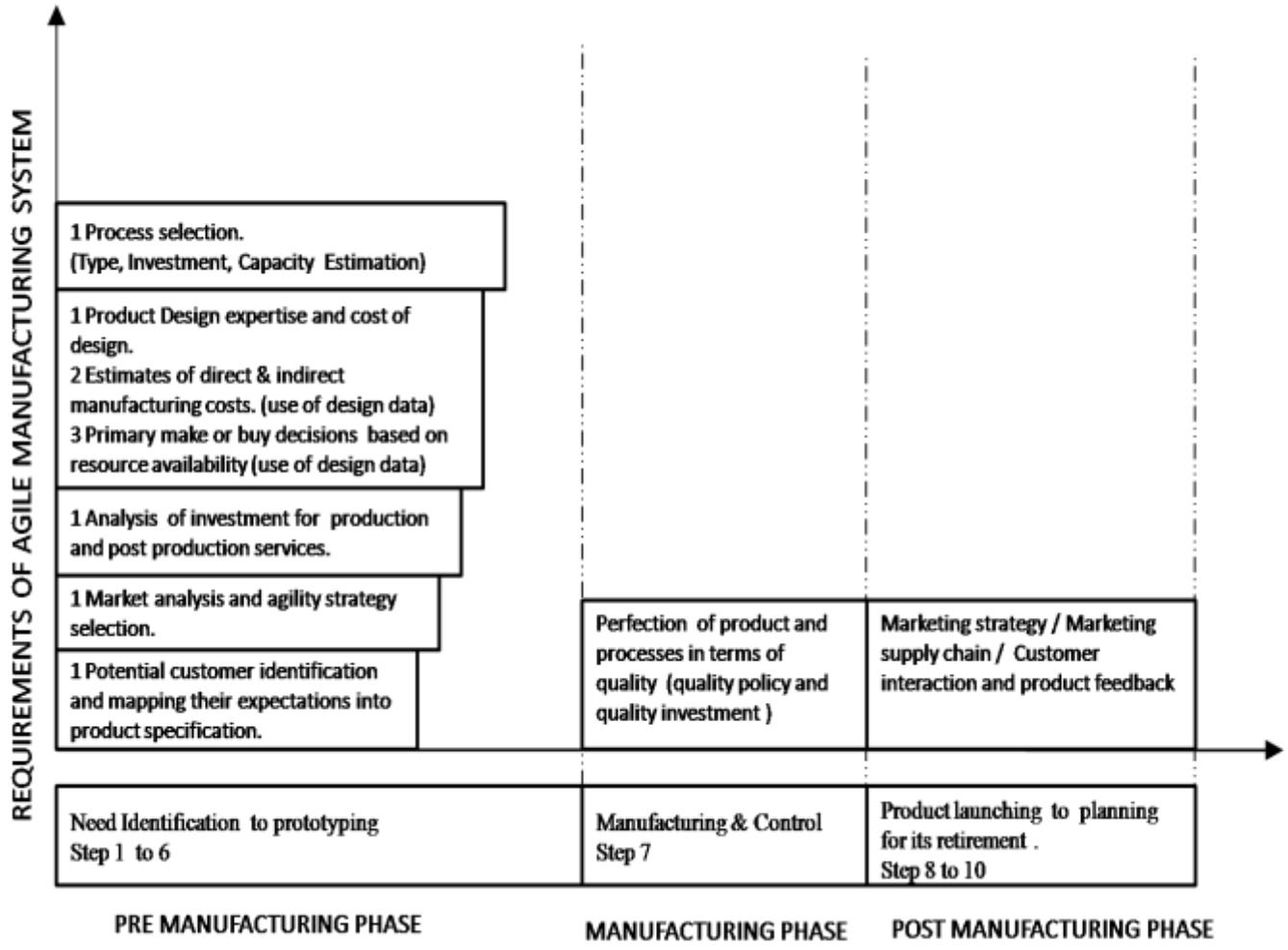

Fig.3 Mapping inputs of product development into requirements of an agile manufacturing

The product development is a process of decision making. Also the manufacturing involves lots of decisions few of which are discussed above. Figure 1 shows the decisions that are considered in this paper for agility. There may be different set of decisions for different scenarios. These decisions are considered as input for product development process. Based on these decisions requirements of agile manufacturing systems are evaluated further in next section.

III. Mapping the Agile Decision Factors into Requirements of Agile Manufacturing System

Instead of mentioning simply the requirements of an agile manufacturing system, we have shown how the resources needed for agile manufacturing systems can be built in product development process. In this case, the figure 3 shows the phases of product development as abscissa and ordinate shows resources needed for agile manufacturing system. In fact arranging this way of data gives clear idea of what kind of resources will be needed in pre manufacturing phase of product development and in what way should the agile manufacturing system be organized. Any changes applied to product development process due to market forces will reflect in ordinate of figure 3.

IV. Conclusion

Does this paper propose an entirely different methodology? Certainly not! Here we viewed the things in slightly different manner. In traditional approach, the agility is viewed as a strategy to operate manufacturing & business operations and to some extent it was considered as characteristics of production systems in terms of production resources and human resources. Instead, we focused on product development and considered factors intrinsic and extrinsic to manufacturing systems which influence the agility. These factors form the input to product development process. Further this exercise is mapped into the requirements of an agile manufacturing system. Figure 3 shows this mapping. The abscissa is stage of product development and ordinate is

the requirements of manufacturing system for agility. One can surely observe that this type of mapping gives an idea about investment and resources needed for agile manufacturing in pre-manufacturing stage (conceptual phase) of product development process. Moreover, the impact of any market factor on product development can be suitably mapped into corresponding requirements of an agile manufacturing and subsequently into alterations needed in investment and resources.

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