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Collaborative Manufacturing for Small-Medium Enterprises

D Irianto[1]
Laboratory of Production Systems, Bandung Institute of Technology
Jl. Ganesha 10, Bandung 40132, INDONESIA

E-mail: dradjad@mail.ti.itb.ac.id

Abstract. Manufacturing systems involve decisions concerning production processes, capacity, planning, and control. In a MTO manufacturing systems, strategic decisions concerning fulfilment of customer requirement, manufacturing cost, and due date of delivery are the most important. In order to accelerate the decision making process, research on decision making structure when receiving order and sequencing activities under limited capacity is required. An effective decision making process is typically required by small-medium components and tools maker as supporting industries to large industries. On one side, metal small-medium enterprises are expected to produce parts, components or tools (i.e. jigs, fixture, mold, and dies) with high precision, low cost, and exact delivery time. On the other side, a metal small-medium enterprise may have weak bargaining position due to aspects such as low production capacity, limited budget for material procurement, and limited high precision machine and equipment. Instead of receiving order exclusively, a small-medium enterprise can collaborate with other small-medium enterprise in order to fulfill requirements high quality, low manufacturing cost, and just in time delivery. Small-medium enterprises can share their best capabilities to form effective supporting industries. Independent body such as community service at university can take a role as a collaboration manager. The Laboratory of Production Systems at Bandung Institute of Technology has implemented shared manufacturing systems for small-medium enterprise collaboration.

1. Introduction

The recent global competitiveness requirements create a tensed business environment that drives companies to improve and innovate continuously. Various efforts have been proposed to find a better way to provide the highest level of quality, competitive manufacturing cost, and synchronized delivery time to market. Some companies are success, but some other is not. Big companies may have different characteristics in their production management with small medium enterprises (SME) [1]. In general, big companies have more capacity and capability to fulfil recent fast shifting of competitiveness requirements. In contrast, SMEs are challenged with many problems that come from limited capacity of resources, weak leadership and management, lack of new product development for business continuity, and unconvincing industrial networking and cooperation [2], [3], [4]. Some efforts have been proposed to improve the weaknesses of SME, i.e. cost reduction, improving product quality, improving implementation of IT or ERP, improving roles in supply chain, improving network collaboration, or developing global strategies [5] [6] [7] [8]. Recently, improvement efforts are

[1] To whom any correspondence should be addressed.

required as an integrated approach including considerations on cost, quality, time to market, delivery, flexibility, and green manufacturing. Integrated model development for improvement becomes a multi objectives optimization [9] [10] [11] [12].

The International Academy of Production Engineering (CIRP) describes manufacturing system as having an integrated group of functions, e.g. marketing, product design, process design, production planning, production process, and delivery to customer [13]. These all activities also define as product lifecycle [10]. In a manufacturing system, the activities are usually started with gathering information from end user or customer in order to understand the customer needs and requirements [14]. These needs and requirements are then translated into variables and attributes of product design. One or more variables and attributes are then considered as important for customer, also known as the quality characteristics. Process design is a process of defining the required processes to realize the product. One or more processes determine the achievement of the quality characteristics, which thus these processes are considered as critical processes that need to control [15] [16]. After following all production processes, the finished product is delivered to the customer as soon as possible. A product may require a specific method for handling in order to maintain its quality so that mode of transportation is important [17] [18].

Changing of paradigm from mass production toward mass customization opens an opportunity for collaboration. In a mass production, manufacturing companies uses the cost plus strategy in which the targeted price is determined by adding profit to the cost (as shown by upward arrow as in figure 1). Using this strategy, the focus is more on production and less to quality that determines customer satisfaction. In contrast, in a mass customization, manufacturing companies uses the price minus strategy in which the targeted cost is determined by subtracting profit to the price (as shown by downward arrow as in figure 1). Using this strategy, the focus is more on the quality in order to satisfy customer, but it could be not feasible to the target cost. As a result, manufacturing companies should find outsourcing partner that has good value adding process to meet the quality but with lower cost. If the appropriate partner is located abroad, the collaboration forms a global supply chain

Figure 1. Cost plus and price minus strategies.

2. Needs for collaboration

In the past, a company may be considered as having very strong capabilities so that all activities of marketing, product design, process design, production planning, production process, and delivery to customer can be performed self-sufficiently. Even if this company has the capability to do all activities, not all activities can be performed efficiently. Each activity has its own limited value adding. This company may have the best competence in some activities, but not in all activities and thus limit its value adding. A company should select its strategic partnership in order to complement its core competence for better value adding [9]. The need for improving competitiveness also create new requirements, namely complex product and services, mass customization, and global outsourcing, which thus the collaboration between industries should be considered [10]. These new requirements give more rationale for proposing collaboration. Even innovation needs collaboration [19].

Improving competitiveness has been done by industries that implement various modern methods and approaches. Among these methods and approaches, the successful implementation of quality engineering in some countries leads to a modern framework for total quality management (TQM). This framework covers internal aspect, i.e. procurement of material (input), manufacturing and production activities (process), and providing quality product and services (output). These internal aspects also relate to external aspects, i.e. supplies of material (supplier), and managing customer. All internal and external aspects form a framework of supplier-input-process-output-customer known as SIPOC as an approach in analyzing an integrated business process [20]. Since there is an increasing attention to the customer, then attention to product and process design is also increasing. Accordingly, the TQM framework can be revised into SIPOC+ that includes product and process design as shown in figure 2.

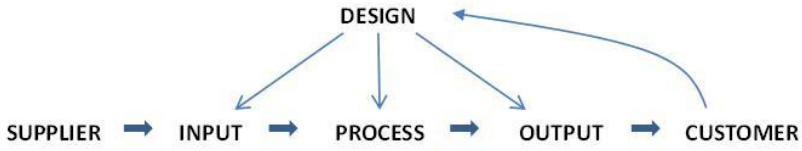

Figure 2. Scope of quality engineering SIPOC+.

3. Restriction in collaboration

The TQM framework SIPOC+ opens an opportunity of collaboration between company and the externals, i.e. supplier and customer. A company should have external relation division to manage supplier and customer. To support management of supplier relation, establishing standardization and material inspection provides assurance of incoming material. Likewise, to support management of customer relation, establishing customer service provides assurance for customer satisfaction. Establishing standardization and material inspection are mostly done through a formal agreement that is written into a formal document. This formal document indicates a contractual based trust so that limits effort for improvement and is mostly done as transactional agreement. If one party considers a deficiency or unevenness from the agreement, then the collaboration is terminated easily.

Contractual based trust is considered not sufficient for long term collaboration. This often occurs in collaboration between SME and bigger companies in supply chain relationship. One important role of SMEs is to support the big manufacturing companies by supplying parts, sub-assemblies, or tools (e.g. jigs, fixture, mold, and dies). SME often faces many uncertainties in its business environment including capacity, delivery time, cost, and quality that make low level of bargaining position of SME. In contrast, big companies often use their advantage to give pressure to SME. Accordingly, SME collaboration is hard to sustain. This case often happens in developing countries where foreign big manufacturing companies start their business using collaboration with local suppliers. The gap operation management and standards between both parties creates problem. Without a good communication skill, the problem can ends in collaboration termination.

4. Building trust in collaboration

Gap of capabilities and poor communication skill are weaknesses for sustainable collaboration based on mutual trust. Inter organizational cooperation in a supply chain is an important aspect for sustainable business strategy. The main issue in this strategy is how to provide internal improvement that also fulfils the requirements of external objectives. This issue is behind the rationale for adopting a quality management system (such as ISO 9000) as the necessary foundation. A quality management system basically promotes the standardization of products, production processes, procedures and

problem solving. Repeated quality auditing enables the evaluation of the existing practices and standards which then turns quality management systems into quality assurance systems. This assurance system is expected to build the capability for socio-cultural interactions that create transparency and trust between internal elements of an organization. From the external viewpoint, internal transparency and trust improve the degree of assurance for external partners. This factor is known as inter-organizational trust; and is a fundamental social capital for collaboration [21].

Developing trust for inter-organizational collaboration also needs awareness on the differences in the existing organizational conditions and practices. Managing collaboration does not only engage with developing mutual objectives but also with creating common understanding and values. Framing joint vision, arranging clear mutual contributions, defining detailed incentive schemes, and securing the means of collaboration are the necessary means for organizing effective interface management [22] [23]. Implementing quality management system also develops the dynamic capability for sociocultural interactions that can contribute towards effective interface management. Quality management implementation is not straightforward; it includes recursive processes of measurement, evaluation and improvement [24]. As this recursive process continues, the affected practices reorient employees into a continuous improvement attitude. The impact of this implementation on the construction of employees' mindsets can be observed, for instance, at Toyota Astra Motors, an Indonesian-Japanese joint venture company in automotive co-makership [25]. These arguments imply that developing internal capability is not as simple; it also faces the differences in the dominant organizational contexts important for collaboration with the externals.

Adapting advanced technology and management in routine activities is expected to improve the organizational dynamic capability. In this case, dynamic capability is considered as the ability to integrate, build or reconfigure internal and external competence to address rapidly changing environment [26]. If the achievements can be maintained, then teamwork, correctness and consistency will have a direct influence on coherence and transparency as essential elements in developing networks. This achievement is seen as the necessary social capital of organizations for interacting with other organizations in a wider society. The success in creating consistency and efficiency, and capturing organizational dynamic capability - is likely to become a model of a 'how to approach' when introducing collaborative improvement into the organization.

5. Conclusions

Developing collaboration between SME and big companies which have different context is not straightforward. Building mutual trust and common value are the most important aspects for successful collaboration, especially for those involving global supply chains. The Laboratory of Production Systems at Bandung Institute of Technology has implemented shared manufacturing systems for small-medium enterprise producing automotive tools (i.e. jig, fixture, mold, and dies). From the implementation, an independent respected body such as laboratory incubator at university can take a role as a collaboration manager.

6. References

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