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Strategic, Tactical Decisions and Information in Rapid Manufacturing Supply Chain

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ABSTRACT

The efficiency and agility of its supply chain is vital to the commercial success of any product. Sharing strategic and tactical information effectively within the supply chain is often a key factor in achieving this goal. This paper proposes a framework to identify strategic, tactical decisions and information. The framework is used to conduct a sector based analysis of the Rapid Manufacturing (RM) industry. The decisions and information identified include amongst others various supply chain strategies and technical information.

KEYWORDS: Rapid Manufacturing, Strategic/Tactical Decisions, Strategic/Tactical Information, Supply Chain, Framework

1. INTRODUCTION

The majority of the industry sectors today have to respond with improved flexibility to changing requirements and collaborate across the supply chain [1]. The need for collaboration in supply chain is highlighted in the work of Lambert and Cooper [1] and Chen and Paulraj [2]. The new collaboration level requires coordination in strategic and tactical management level and therefore a new paradigm of data and information sharing with supply chain partners. The collaborative supply chain concept will be applicable to the Rapid Manufacturing (RM) industry with the increasing usage of the technology to produce “end-used” products. Hence, the RM supply chain will only be part of a wider supply chain which potentially will be collaborative in nature. In the perceived circumstance, it is important to identify the important strategic and tactical decisions/information that can be coordinated within the RM supply chain. The paper identifies important decisions, information in the RM supply chain and classifies them as “strategic” and/or “tactical” through the means of a proposed Strategic/Tactical Information-Decision Framework. Such classification would potentially help management to distinguish between the necessary attention, proper planning and allocation of appropriate resources that are needed for future coordination of these decisions and information in the supply chain.

2. CONCEPT OF STRATEGIC/TACTICAL DECISION-INFORMATION FRAMEWORK

The terms “strategic” and “tactical” are more appropriate when used describing a plan or a decision. A strategic plan or a decision would be concerned with the “what and the why”

looking at the big picture. It requires the ability to recognise patterns and trends, establish priorities, anticipate issues, and predict outcomes. To some extent strategic plans involve the vision, the mission, the guiding principles and the goals for the business; whereas, a tactical plan or decision would be concerned with on how to achieve the strategic goals [3]. In line with this argument, in a research regarding strategic and tactical planning in a hospital it was identified that strategic information management goals depend on the tactical information management responsibilities [4]. Some researchers have differentiated between the levels (there are three levels in decisions namely: strategic, tactical and operational) through the decision time horizon [5]. That is strategic and tactical decisions have been categorised as long and medium term decisions respectively [5]. Strategic and tactical decisions can result in strategic and tactical information exchange respectively. It is an assumption that strategic and tactical information would follow the same hierarchy as strategic and tactical decisions, in terms of their relative importance. Another important assumption this paper makes is that information directly affecting a strategic/tactical decision is potentially strategic/tactical in nature. In their research Grientein et al [6], distinguished between strategic and tactical information in market research by the means of who accessed it. According to them, strategic market information is used mostly by top managers in strategic decision-making and impacts the firm's long-term behavior. On the contrary, tactical market information is often collected and interpreted by lower level managers and employees. However what makes information to be of strategic and tactical importance may be debatable. Therefore, anything strategic and tactical is more importantly context dependent. On the basis of existing literature and authors interaction with various industry sectors the Strategic/Tactical Decision-Information Framework is proposed in Figure 1.

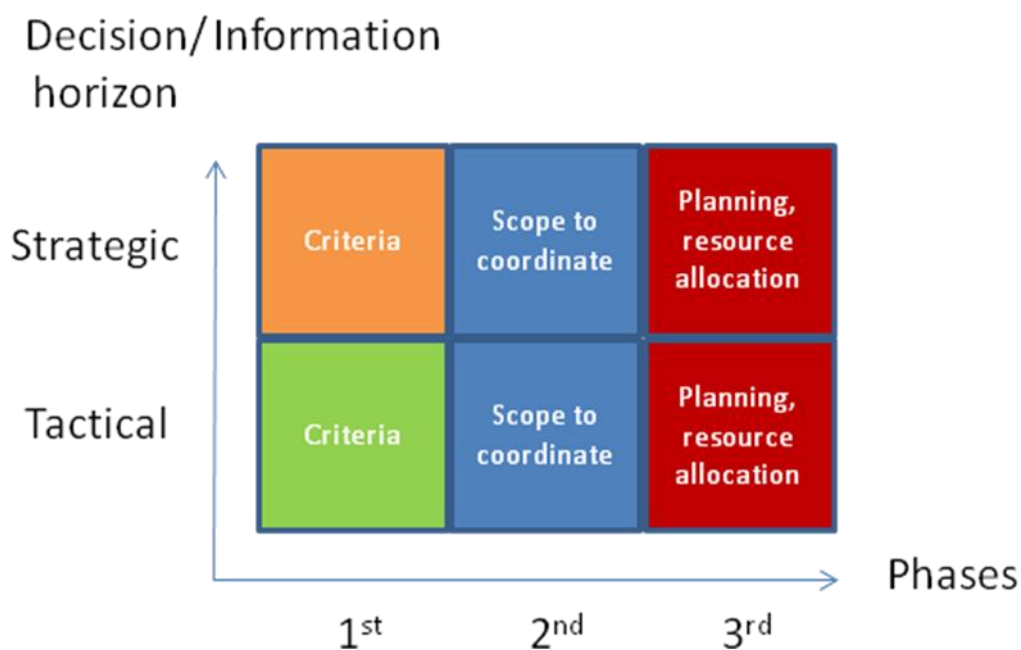


Figure 1 Three phases of the Strategic/Tactical Decision-Information Framework

In the 1st phase, the task is to identify the strategic, tactical decisions and information in the supply chain; whereas in the 2nd phase the priority is to investigate the scope of coordinating those decisions within the supply chain. This includes context based analysis of advantages, risks and other appropriate factors related to coordination. In the 3rd phase, the objective is to

prepare the necessarily plan, methods and resource allocation to implement the supply chain coordination. However, this paper would limit its discussion to implementation of the 1st phase of the framework. Accordingly, criteria set to classify strategic, tactical decisions and information is provided in Table 1.

Table 1 Criteria for the 1st phase of the Strategic/Tactical Decision-Information Framework

| Strategic decisions criteria | Tactical decision criteria | Information: strategic or tactical |
|--|---|---|
| <ul style="list-style-type: none"> • Goals of the business • Recognise vision • Recognise patters • Recognise trends • Recognise priorities • Recognise mission • Context of the situation • Long term decisions • Top management involve | <ul style="list-style-type: none"> • How to achieve the strategic goals? • Midterm decisions, • Mid level Management involved, • Context of the situation | <ul style="list-style-type: none"> • Strategic information directly affects strategic decisions, useful for top management, context dependent, affects long term company goal, vision and significantly impacts cost, innovation, employee consequence issues amongst others • Tactical information affects tactical decisions, useful for mid-level management, context dependent, affects many important issues |

3. STRATEGIC and TACTICAL DECISIONS in RM SUPPLY CHAIN

The 1st phase of the framework discussed in the previous section will be used to analyse the RM supply chain. The decisions and information discussed in this paper have been identified through literature review, interviews and interaction with academics, industry consultants, RM service providers, RM system manufacturers [7].

RM has evolved from Rapid Prototyping (RP) technologies that have been successfully used to physically create designs and concepts. RM is concerned with the direct manufacture of parts and components using additive manufacturing techniques [8]. One of its particular advantages over these traditional techniques is that no tooling is required to manufacture a component [9]. The major difference between RP and RM is that the RM products are intended for end use, not just as a prototype as it is in the case of RP. However, a number of businesses are undoubtedly performing RM with RP methods [8]. Hence some of the decisions and information discussed in this paper also concern the RP technology. It is important to first identify the major stakeholders in RM supply chain and it includes: the company interested in RM products, service bureaux who provides specialised RM services, RM system/technology manufacturers, material and other accessories providers, consultancy and other service providers, individual customers and other entities involved in the overall supply chain. The obvious decisions some of the above mentioned entities in the supply chain makes include “Make products with RM technology”, “Make in-house”; and supply chain strategies that RM technology can potentially help fulfil such as “agile supply chain”, “lean supply chain”, “Just-in-time” [10]. In addition, there are strategies such as “Manufacture in the logistic supply chain” which is applicable in the case of Mobile Parts Hospital (MPH)

program of US military. MPH program has manufacturing systems in logistic line (for example ships) in order to provide critical replacement and spare parts to vehicles or systems that have been damaged in the battlefield [11]. Another example is “track side production” strategy which emphasises to have RM facilities in multiple strategic locations which can be useful in the Aerospace industry [12]. In addition, there are decisions like concept development, production design, assembly and integration to name a few. It is interesting to investigate how the decisions in the RM supply chain are often somewhat dependent to each other. This paper would attempt to elaborate on the issue; as mentioned in the Strategic-Tactical-Decision-Information Framework, an elementary way to distinguish between strategic and tactical decision is:

- Strategic decisions- vision, mission, goals of the business
- Tactical decisions- how to achieve those goals

According to this analogy tactical decisions are often made to implement strategic decisions. Figure 2 illustrates the concept and shows that certain tactical decisions are linked up to strategic decisions.

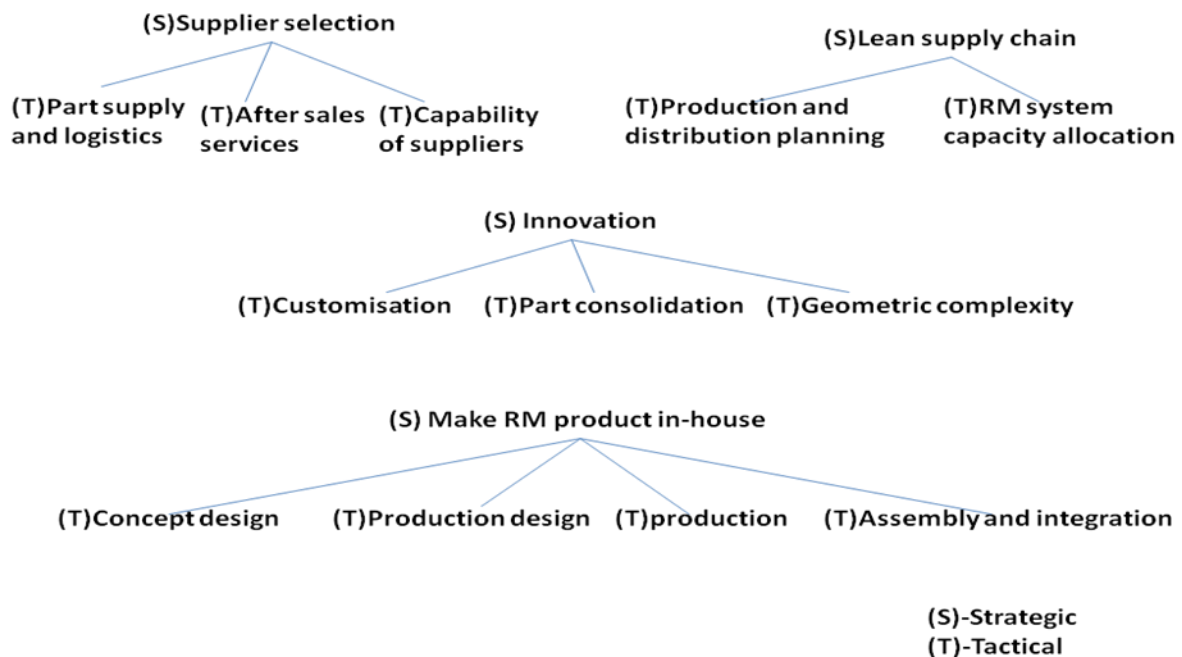


Figure 2 Tactical decisions are often linked up to strategic decisions

Figure 2 although being a significant illustrator of the analogy, however does not tell the full story. Another important parameter to distinguish between strategic and tactical decisions is “context”. In line with this argument, a decision can be made to implement a more important decision but both the decision can be thought of as strategic. This can be due to the significance and context of the situation. Figure 3 shows several decisions can be made to implement a decision but all of them can be thought of as strategic due to significance/importance of those decisions and the context of the situation.

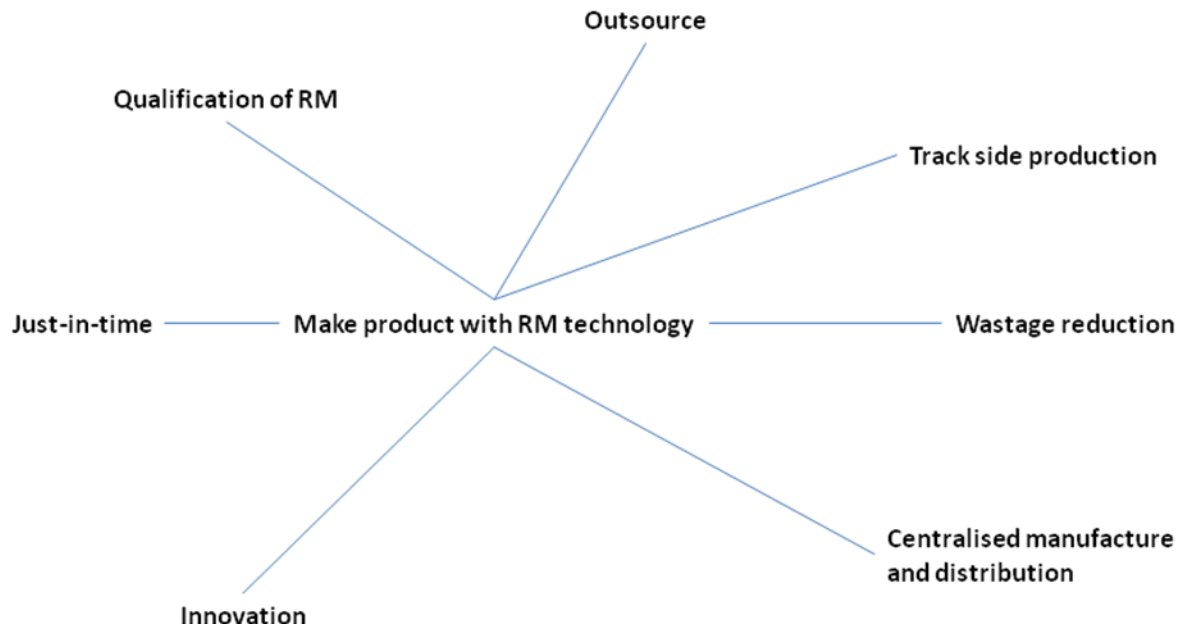


Figure 3 Several strategic decisions can be made to implement another strategic decision

An example of significance of the word “context” in determining strategic and tactical can be found when we look at a decision regarding “customisation”. An option where a customer chose between colours and select where the logo to be [13] can be thought of as a tactical decision because it will require relatively less changes in the overall goal of the company and less resources to implement. However, a decision to have custom seats, steering wheels, gear knobs and hand brakes [10] is potentially strategic since it would require greater investment, entire reconfiguration of the business strategy, if compared to the “colour and logo” example provided earlier.

The examples provided so far (Figure 2 and 3) illustrate how the Strategic/Tactical Decision/Information Framework can be used to distinguish between strategic/tactical decisions and the significance of context in making each of these types of decisions. In accordance to the criteria set in the framework provided in Table 1, strategic decisions identified in the RM supply chain have been analysed and results outlined in Table 2. The strategic decisions have been further categorised in 4 different types namely:

- *Basic decisions:* These decisions are taken when a business initiates to explore the use of RM technologies and provided the decision is affirmative, then they go on to make other basic decisions such as “make or buy” etc.
- *Market and technical decisions:* These decisions include market oriented decisions such as customer distribution/focus and technical decisions such as customisation strategies.
- *Supply chain set-up strategies:* These decisions are made to set up manufacturing, production strategies in supply chain such as whom to outsource, in which location to employ resources and set up production.
- *Broader supply chain initiatives:* This includes various supply chain goals that RM technology can help achieve.

Table 2 Strategic decisions as per the Strategic/Tactical Decision-Information Framework

| | |
|--|---|
| Strategic decisions: <i>goals of the business, looking at the bigger picture, recognise vision, patterns, trends, mission, context of the situation, long term decisions, top management involved</i> | |
| <p>Basic decisions</p> <ul style="list-style-type: none"> • Make product with RM technologies • Make RM products in-house • Outsource • Suppliers selection • Facility allocation <p>Market and technical decisions</p> <ul style="list-style-type: none"> • Innovation • Appropriateness/ Qualification of RM • Market selection • Customisation • Customer distribution • Design • Intellectual property | <p>Supply chain set-up strategies</p> <ul style="list-style-type: none"> • Track side production • Production at the retailer • Hub based production • Manufacture in the logistic supply chain • Centralised Manufacture and distribution <p>Broader Supply chain initiatives</p> <ul style="list-style-type: none"> • Lean supply chain • Agile supply chain • Just-in-time • Wastage Reduction strategies |

Similar to the strategic decisions, the tactical decisions (Table 3) identified are grouped into the following categories:

- *Product life cycle decisions:* This includes all decision made from concept design-to-after sales issues
- *Technical decisions:* This includes decision to customise, change design etc.
- *Production and SCM decisions:* This includes all tactical level decisions regarding production and over all chain management.

Table 3 Tactical decisions as per Strategic/Tactical Decision-Information Framework

| | |
|--|--|
| Tactical decisions: <i>“How to achieve the strategic goals?”</i> , <i>midterm decisions, midlevel management involved, context of the situation</i> | |
| <p>Product life-cycle decisions</p> <ul style="list-style-type: none"> • Concept design • Production design • Prototyping • Preproduction • Production • Part supply and logistics • Assembly and integration • Customer distribution • After sales services | <p>Technical decisions</p> <ul style="list-style-type: none"> • Customisation • Geometric complexity • Part consolidation • RM systems/platforms <p>Production and SCM decisions</p> <ul style="list-style-type: none"> • Capability of suppliers • production and distribution planning • RM system/platform capacity allocation • Safety stock placement for materials |

4. STRATEGIC and TACTICAL INFORMATION in RM SUPPLY CHAIN

Information in the RM supply chain have been analysed and classified as strategic and/or tactical according to the framework. It should be mentioned that information considered for this analysis have been identified through authors interaction with the RM industry and

literature sources. Following are information in the RM supply chain that can be considered both strategic and tactical depending on the context and situation.

Information considered both strategic and tactical

- Material safety data
- Design information
- Information regarding non-RM hardware cost
- Information regarding application of the product
- Information regarding assessing the application of the part to qualify for its purpose and strength
- Knowledge of technical know how

The information classified have also been categorised according to types. There are broadly four types of strategic information identified namely: material related; product development related, market and sales related; and, cost and technology related information. The essence of grouping information such as “long term material property data”, “RM growth information”, “cost related data” and technical information such as “qualification of part” is to ensure that appropriate management can interpret them efficiently. Table 4 outlines the potential strategic information types that can be potentially coordinated within the supply chain. It should be mentioned that the number of strategic information identified in the process is 32.

Table 4 Strategic information categories

| Strategic Information | |
|--|--|
| <p>Product development, Market and Sales</p> <ul style="list-style-type: none"> • RM growth information • Information regarding market trends • RM machine sales information • RM demand information • Supplier profile • Information regarding capital equipment depreciation • Information regarding market of RM products • Information regarding need of individual equipment owner • Information regarding public acceptance • Information regarding competitors product • Information regarding buyers priority • Knowledge companies broader strategy information regarding suppliers services <p>Materials related information</p> <ul style="list-style-type: none"> • Long term material property data • Material supply information | <p>Cost related information</p> <ul style="list-style-type: none"> • RM system cost information • Material cost information • Information regarding software purchase cost and upgrades • Information regarding labour cost for machine set-up and any required post-processing • Information regarding capital equipment maintenance costs per annum • Overhead costs incurred due to production, energy and floor space <p>Technology related information</p> <ul style="list-style-type: none"> • Information regarding qualification of parts • Information regarding certification • Large company acceptance data • Information regarding intellectual property issues • RM system/platform characteristics/capability information • Information regarding available RM technology/system) |

In a similar process 41 types of tactical information considered have been categorised in 6 groups namely: Technical information; Cost; Material, Design, Production related information; and Market, procurement and logistics related information. Some of the information within these categories includes production related information such as “capacity availability”, design information such as “design intent” to name a few. Table 5 outlines the tactical information types.

Table 5 Tactical information categories

| Tactical Information | |
|---|--|
| <p>Technical related information</p> <ul style="list-style-type: none"> • Information regarding geometric complexity • Part inspection protocol information • Technical support information • Information regarding post operation • Information regarding accuracy • Information regarding surface finish • Information regarding technology requirements • Information regarding speed of manufacture • Information regarding scheduling procedure • Information regarding cycle time • Product disposal recycling information • Information regarding process automation <p>Materials related information</p> <ul style="list-style-type: none"> • Material forecasting information • Knowledge of material of manufacture • Information regarding range of material • Material batch recording information <p>Design related information</p> <ul style="list-style-type: none"> • Information regarding design intent • Information regarding original design for manufacture (for reverse engineering) • Information regarding new methods of design for manufacture • Assessment of route to manufacture | <p>Production related information</p> <ul style="list-style-type: none"> • RM production information • Information on capacity availability • Product lifecycle plan • Performance status information • Quality assurance procedure instruction • Throughput information • Sub-assembly information <p>Market, Procurement and logistics related information</p> <ul style="list-style-type: none"> • Availability of market demand information • Information regarding Batch size • Information regarding need of individual equipment owner • Advertisements • Procurement information • Suppliers information sheet • Purchase orders • Information regarding method of delivery |

5. CONCLUSION

This paper, using the 1st phase of the Strategic/Tactical Decision-Information Framework identified 21 strategic, 17 tactical decisions, 32 strategic information and 41 tactical type of information that have the potential to be coordinated within the RM supply chain. Amongst the identified decisions and information 1 decision type and 6 types of information can be considered as both strategic and tactical. This paper should provide some guidance on the

decisions/ information, a company should consider for coordination in the RM supply chain. In addition, company management should think about to initiate a plan and allocate appropriate resources, for the specific decision/information that are to be coordinated.

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