

Effective Integration of Manufacturing Strategy

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Abstract

As we move further into the 21st century there is increasing competition among organisations to operate efficiently, hold on to their market share and capture additional share from their competitors. Achievement of these goals depends on a number of factors. One of the routes that are pivotal to a positive contribution is effective alignment and application of manufacturing strategy. This requires visibility of the current level of the organisation that will help direct the strategy in the appropriate direction to achieve maximum benefit. Additionally if the organisations can get a good understanding of their current positioning and level, they can proactively pursue to move to the next level.

While the above mentioned may seem straight forward, it is not due to various reasons. There is also the absence of effective routes to facilitate organisations to take this step with confidence. The lack of some form of guidance can be an issue especially for Small and Medium Enterprises (SMEs). Understanding the key problem and gaps will establish suitable guidance in this area that organisations can use. This paper will demonstrate the gaps, highlighting the classification of available framework and understanding the need to establish systems that would provide support to organisations.

Key words

Manufacturing strategy, taxonomies, small and medium enterprises, competitive strategy, Hayes and Wheelwright's four stage model

1. Introduction

The manufacturing industry in the UK account for 10 percent of the economy, employing 2.6 million people and contributing to £148 billion UK gross value added (GVA) in 2013 – the increase on competitiveness of the industry could boost the UK economy around £30 billion by 2025 (HM Government Department of Business, Innovation and Skills 2015). The sector is not only consisting of large manufacturers but also supported by suppliers which are largely small and medium enterprises (SME) – which remain an integral components to the sectors. The sector faced challenge provided by globalisation and economic liberalisation, where strong competition emerges from low cost economies in addition to other industrialised nation such as Japan, South Korea and Germany. To keep up with the changes in the competitive environment faced by the manufacturing SME, the UK government (Department of Business, Innovation and Skills 2015) had suggested support to be directed in several areas namely strategic management, skills and training, finance, standards and innovation. It is imperative SMEs to remain competitive and get the right support from governments, large multinationals as well as research and academic institutions. In light of this, the paper intended to provide a contribution from an academic point of view on the process of becoming a competitive enterprise by looking at the need to establish a manufacturing strategy.

2. Manufacturing Strategy Taxonomies and Topologies

There are various methods used by firm and academic to develop manufacturing configurations, which in the end created a manufacturing strategy (MS). Dangayach and Deshmukh (2001) discover 260 papers relating to the manufacturing literature from its inception from year 1969 up to 1998. It demonstrates that there is vast study which had looked into the same area and the work is still evolving to this day. Bozarth and McDermott (1998) bring up the issue of difficulties in categorising those frameworks as a result of having large amount of them in the literature. He came out with a description which categorises the MS framework into two groups namely: topology and taxonomy. This is later adapted by Martin-Pena and Garrido (2008) see table 2.1.

Table 2.1: Difference between MS topology and taxonomy.

	Typologies	Taxonomy
Definition	Ideal types	Classification of real organisations in representative and mutually exclusive groups
Objective	To match one of the ideal types theoretically proposed to obtain better results	To obtain stable groups by using several techniques and data samples
Approach basis	Mostly conceptual	Mostly empirical
Key features	Generic theories for all type and theories for each types Can be empirically tested	Right choice of classification variables. Not influenced by techniques of samples. Can be used to generate knowledge.
Result of procedure	It is formed before classifying organisation into class. Previous theories are used rather than using empirical data.	Emerges from empirical process to describe groups of companies on degree of similarities between variables or characteristics.

Table 2.1 shows the key differences that it possesses by the two types of MS framework. Of the two, the paper is interested in looking in-depth into the MS taxonomy. This is supported by three reasons: first, the methods used to classify the group are the representation of real organisation. Second, it allows generation of knowledge that can further the understanding of a phenomena thus generating new theories. Third, it overcome the limitation of topology, which trying to match ideal companies which could fit in with the framework - by allowing the variations of manufacturing organisations to be grouped into the right choice of classification variables (Martin-Pena and Garrido 2008). Nevertheless cautious approach needs to be applied in setting the classification rules as it can be exhaustive. The next paragraph will provide example on the MS taxonomies, before focusing on one which the paper intends to discover further.

3. The MS taxonomy framework

The Miles and Snow (1978:29) framework is from the interpretation of existing literature and continuous studies on 84 companies from four industries in the US. The framework informed the alternative strategies companies adopted and the structure as well as the process involved, mainly describing their behaviour towards competitors (Miller and Roth 1994). They went to create a classification showing how organisations move within the cycle by classifying it into four phases: (*defenders*) rely on certain market niches, (*analyser*) operate in stable and changing product-market domain, (*prospectors*) continually looking for market opportunities and (*reactor*) no consistent patterns, usually adopt changes when pressured by the market. The taxonomy shows that the role that companies focus by looking at specific strategies and the way decision are made. There are other similar work which follow similar theme such as Miller and Roth (1994), Kathuria (2000), Sum *et al.* (2004), Ward *et al.* (2007) and Andersen (2012). The paper did not intend to review all the taxonomies in detail, but focus on the next one in the following paragraph.

The paper identified the four stage model (Hayes and Wheelwright 1984:396) as the one it intended to explore further. This is resulted from several reasons:

- Most of the framework currently asking question such as “where are we now?” and “what we are doing?”, while the four stage model put an additional perspective to it by asking “where should we be?” and “what we need to do to get there”.

- The framework depicts a journey or progress rather than merely focus how companies positioned itself in the marketplace or capabilities they are pursuing. Thus giving a sense of direction on the way companies evolve or regress. In turns opening an opportunity for the process to be studied further.

Excluding the Miles and Snow (1978:29) taxonomies, it is found that the work by Hayes and Wheelwright are more in-depth, taking from an interpretivism point of view rather than objectivism. The classification of firms is based on the author’s years of experience in conducting research and consultancy among US companies. As a result, it uncovers some elements of competitive priorities, decision making and the role of manufacturing as were viewed by the management. In order to evaluate the strategic role of manufacturing function of a company, Hayes and Wheelwright (1984:396) develop a four stage model. In their opinion, there are four ways on how company position their manufacturing function in their competitive strategy. See figure 2.1.

Stage 1 - Minimize Manufacturing’s negative potential
In stage 1, manufacturing is viewed as a function that needs to be operated without major problem. Most of the time, experts are used in making strategic management issues. Top management believe investing in new technologies and equipment, but lack emphasis on improving planning and measurement system and employee policies
Stage 2 - Achieve parity with competitors
Industry practice in equipment, process and practice are adopted, with the aim of achieving parity with competitors. Operations planning include units outside manufacturing and capital investment is favoured means to achieve comparative advantage.
Stage 3 - Provide credible support to the business strategy
In the third stage, firms expect manufacturing functions to provide credible and significant support to its overall business strategy. Decision is screened to make sure that they are aligned with the business strategy. Practice like JIT, TQM and Lean Manufacturing are introduce to enhance products
Stage 4 – Pursue a manufacturing – based competitive advantage
Manufacturing capabilities is expected to play a major role in achieving business strategies. Investment in in-house process and product improvement are on-going with the aim of becoming leader in the industry. To some extent manufacturing strategy is actively involved in making major decision for the company.

Figure 2.1: The Four Stage Model (Hayes and Wheelwright 1984:396)

The Four-Stage model is taxonomy of an evolutionary approach of what production went through until being considered a functional area of strategic importance and essential competitive edge in any organisation (Martin-Pena and Garrido 2008). The model provides a reference in determining manufacturing strength and hence possible direction to pursue – thus becoming a diagnostic tool that can be used to appraise manufacturing role within a firm (Gilgeous 2001) and (Jain *et al* 2013). It must be noted that the position of the company along the stage can ascend or descend from one stage or the other. The model can be useful to managers in providing the strategic direction on where they are currently at and where they should be. Even though the work is widely accepted by academicians, Hayes and Wheelwright did not describe how a firm should go from one stage to the other. Therefore opening up a research opportunity to establish a framework which can address how the process is carried out.

4. The Hayes and Wheelwright Four Stage Model (1984:396)

The Hayes and Wheelwright Four Stage Model (FSM from now on) are being actively tested since its inception in 1984 until 2013 according to the latest search. The original concept of the FSM is expanded by Chase and Hayes (1991) to include service firms. Their article classified service firms into: Available for Service (stage 1), Journeyman (stage 2), Distinctive Competence Achieved (stage 3) and World Class Service Delivery (stage 4).

At this point, subsequent work was published to test and operationalize the model. Bates *et al* (1995) examined relationships between organisational culture and manufacturing strategy. They operationalise the model by using Likert scale and classified 41 US and Japanese- owned plants located in the US according to the FSM. They managed to demonstrate links between stage 3 and 4 with organisational culture. However, they found questions relating to stage 1 and stage 2 unreliable. Newman and Hanna (1996) complemented the four FSM by integrating the

model with environmental awareness. They classified stage 1 (environmental reactor), stage 2 (environmental benchmarker), stage 3 (environmental intergrator) and stage 4 (environmental innovator).

Hum and Leow (1996) operationalise the FSM as a strategic manufacturing audit tool using questionnaires from 55 electronic manufacturing plants in Singapore. Their study however limited to examining stage 2 and stage 4 using decision categories. Their research finds most companies are positioned between stage 2 and 3, and moving towards stage 3 in manufacturing effectiveness. Hum (2000) apply the FSM in a third party logistic company using a single case study. The study is exclusively intended to probe stage 4 companies by applying the 'litmus test' guidance provided in the original book.

Swamidass *et al* (2001a) using three companies case studies explore the participation of manufacturing managers in strategy development process in the FSM. They found out that in Stage 1(manufacturing managers have very little control), stage 2(allowed to form plans, independent business strategy), stage 3 (manufacturing plans screened against business strategy) and stage 4 companies, manufacturing plans are key to business strategy. The study limits the coverage to only stage 2 and 3+ on the FSM. In different paper, Swamidass et al (2001b) used three case studies to discover the alternative patterns of manufacturing strategy development according to the FSM. They found evidence of informal manufacturing strategy development such as following patterns of incremental actions (stage 1), adopting improvement program (stage 2) and going for core competencies development (stage 4). However, there is no evidence on the testing of stage 3 companies.

Gilgeous (2001) identified five factors that affect manufacturing effectiveness based on the FSM. They are attitude of top management towards manufacturing, involvement of manufacturing managers in setting the strategic direction of the firm, the emphasis on formulating manufacturing strategy, proactiveness and coordination between manufacturing and other functions. They created a model based on these 5 elements and linked them with manufacturing competence. Using questionnaires send to 295 British companies, they validated the model and found there are only stage 2 and 3 companies in their sample.

Dangayach and Deshmukh (2003) used Likert type questionnaire to 100 Indian automobile, machinery and process companies. They managed to yield results showing companies at stage 2, 3 and 4 with the majority being at stage 4. Dangayach and Deshmukh (2006) again conduct the same application of the model, this time using case studies in three companies by looking at 5 areas namely (order-winners, top three improvement activities, top three competitive priorities, person who formulated MS and focus of MS).

Barnes and Rowbotham (2004) operationalise the FSM in a variety of UK organisations including manufacturing and service, profit seeking and non - profit. Using a three point Likert scale, they found just under half of the answers received can be categorised into a single dominant stages of the FSM, and some companies even positioned themselves to more than a single stage. They identified a few issues that contributed to the results such as respondents which did not fully understand some or all the questions, respondent which not have adequate level of knowledge regarding their organisations and respondent which wanted to represent their organisation in best possible light.

Rowbotham and Barnes (2004) again use questionnaire in testing the FSM. This time they use the questionnaire in conjunction with three case studies conducted in UK manufacturing SMEs. The use of the case studies helped them in validating findings from the questionnaire by confirming the position of the companies along the FSM. They found studied SMEs are categorized into stage 1, 2 and 4 of the FSM. Further they identified what drives the need to conduct strategic review and having a manufacturing strategy for the three companies. The study by Rowbotham and Barnes (2004) are the first which specifically mention SMEs as the target group. Their study validated the characteristics of stage 1, 2 and 3 of the FSM while generating additional findings as mentioned above. Nevertheless they stopped short of giving indication how achievement on each stage, particularly stage 2 and 3 are carried out.

Jain *et al* (2013) develop a questionnaire by identifying four factors that affect the strategic role of manufacturing according to FSM. They interpret FSM according to two sources (Hayes and Wheelwright 1984:396) and (Chase and Hayes 1991) into four categories which are catalyst of manufacturing initiatives, proactiveness of manufacturing function, attitude of top management towards manufacturing and nature of manufacturing initiatives. They managed to come out with 14 items but did not validate the model. Table 2.2 summarise the previous work around the model and some gaps identified. It also shows the method used, sample size and geographical description of the studies.

Table 2.2: Studies incorporating the H-W Model.

Author	Region of studies	Methods	Sample size	Stage involved	Summary
Bates et al (1995)	US	Questionnaire	41 plants (822 respondent)	3 and 4	Investigating relationship between organisational culture and manufacturing strategy by using the FSM.
Newman and Hanna (1996)	US	Survey/Questionnaire	22	1,2,3 and 4	Develop a framework to integrate environmental management into the FSM
Hum and Leow (1996)	Singapore	Questionnaire	55	2 and 4	Testing the 10 decision categories of the FSM.
Hum (2000)	Singapore	Single case study	1	4	Apply the stage 4 litmus test to evaluate whether a company a truly a stage 4 level.
Swamidass (2001a)	US and the UK	Case studies/questionnaire	1 US & 3 UK (4)	2 and 3	Identifying manufacturing manager level of participation in FSM stage 2 and 3
Swamidass (2001b)	US	Case studies	3	1,2 and 4	Identifying patterns of strategic development process by stage 1,2 and 4 companies on the FSM
Gilgeous (2001)	UK	Questionnaire	295	2 and 3	Validating stage 2 and 3 on the FSM.
Dangayach and Deshmukh (2003)	India	Questionnaire	100	1,2,3 and 4	Testing FSM on three industries in India.
Barnes and Rowbotham (2004)	UK	Questionnaire	460	1,2,3 and 4	Testing the FSM in manufacturing, service, profit and non-profit organisations in the UK.
Rowbotham and	UK	Questionnaire and	3	1,2 and 3	Formulate and

Barnes (2004)		case studies			validate questionnaire to classify companies according to FSM in UK SMEs.
Dangayach and Deshmukh (2006)	India	Questionnaire + Case studies	23 questionnaire and 3 case studies	1,2,3 and 4	Testing FSM in Indian machinery manufacturing companies and identifying 5 strategic important issues on three stage 2 and 3 companies.
Jain et al (2013)		Questionnaire	28	1,2,3 and 4	Develop a questionnaire to measure companies according to the FSM.

5. Transition between the stages on the FSM

One of distinguishing characteristics of strategy is, it sets the general directions in which the firms' positioned will grow and develop – sequentially asking the question of “Where are we now”, “Where do we want to be?” and “How shall we get there?” (Ansoff 1984:31-32) , (Barnes and Rowbotham 2004) and (Bordum 2010). The majority of 11 literatures around the application of the FSM are found to answer the first question and partially addressing the other two. Therefore there is a need to further look into addressing the second and third questions. As a result, there is a research question that needs answers:

“How companies improve their position along the FSM and what are the process involved?”

During the inception of the FSM, Hayes and Wheelwright (1984:403-408) described transition journey from stage 3 to stage 4 by providing case studies on how General Electric and IBM achieved them. However, it is found majority of later studies did not extend this work, but rather limited to classifying their samples according to the description provided by the FSM. Thus not addressing how a firm should move themselves along the FSM. Hence there is a need to address this gap by identifying the process of moving from one stage to another.

At least two studies provide indication on the process. First is from (Swamidass 2001b) but their findings are limited to identify the type of action carried out in every stage of the FSM. Second is from Dangayach and Deshmukh (2006), where they managed to find out activities of improvement of stage 2 and 3 companies.

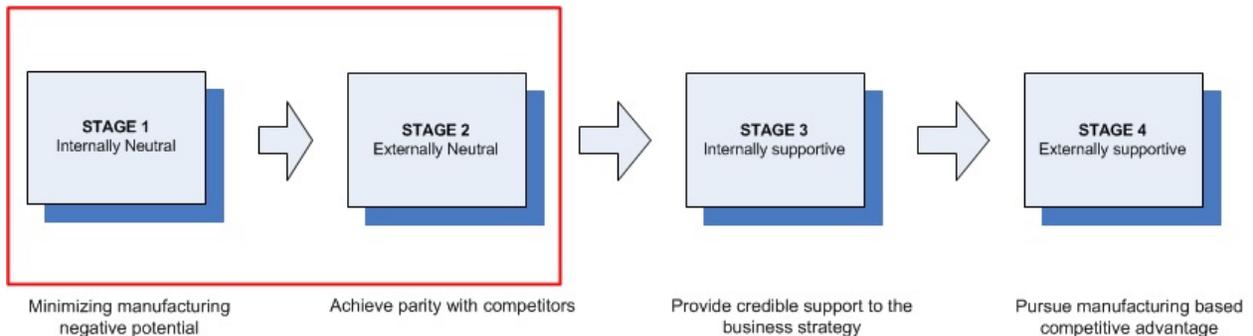


Figure 5.1: Four stage of improvement on the FSM

The geographical limitation and identification of other enablers in moving to stage 2 are the gap identified from the work by Swamidass (2001b) and Dangaych and Deshmukh (2006). In addition, most of the reviewed works apply the taxonomy without specifying the categories of the companies (small, medium or large enterprises). Therefore there is a need to add findings to the body of knowledge by:

- Expand the work in the context of small and medium enterprises (SMEs) as they represent the vast majority of business (Roy *et al.* 2013).
- Identify other key enablers to move to stage 2 on the four stage model.

There is evidence from the literature showing the FSM was tested partially either by selecting one, two or three combination of the stages (Table 2.2). Studies identifying MS development process are focusing in probing companies in stage 2 (Swamidass 2001a) and (Dangayach and Deshmukh 2006). Taking a similar approach, this paper is aiming to probe the process of becoming a stage 2 company on the FSM. In turns refining the research question:

“How companies move from Stage 1 (Internally neutral) to Stage 2 (externally neutral) on the FSM?”

The above explanation shows the importance to look at the movement to stage 2 of the FSM (outlined in red, *Figure 5.1*). The underlying reasons to probe the movement from stage 1 to stage 2 are due to two important reasons first is because stage 1 companies need to build a good foundation in improving their performance so that they will have a clear direction and continually improve to move up the stages. Second, it is important to have a good start as level 1 company that goes backwards might not have a chance to correct them and might face closure. As with level 3 or 4 companies, they have at least a level down to look at or before they can correct things. In order to differentiate and identify stage 1 and stage 2 characteristics, interpretations from 2 papers from the original authors are provided in table 2.3.

Table 2.3: The description of Stage 1 and Stage 2 companies

Author	Stage 1	Stage 2
Hayes and Wheelwright (1984:396)	<ol style="list-style-type: none"> 1. External experts are used in making decisions about strategic manufacturing issues. 2. Internal management control systems are the primary means for monitoring manufacturing performance. 3. Manufacturing is kept flexible and reactive. 	<ol style="list-style-type: none"> 1. Industry practice is followed. 2. Planning horizon for investment decision is extended to incorporate a single business cycle. 3. Capital investment is primary means for catching up to competition or achieving competitive edge.
Chase and Hayes (1991)	<ol style="list-style-type: none"> 1. Customer stays with the firm for reasons other than performance. 2. Operations are reactive, at best. 3. Quality is highly variable. 4. Customer is unspecified, to be satisfied at a minimum costs. 5. Technology is introduced for survival. 6. First line manager’s job is to control workforce. 	<ol style="list-style-type: none"> 1. Customer neither seeks out nor avoids the firm. 2. Operations functions in a mediocre, uninspired fashion. 3. Quality meets some customer expectations, consistent in one or two dimensions. 4. Market segment whose basic needs is understood. 5. New technology justified by cost savings. 6. Workforce follows a set of procedures 7. First line managers control the process.

In addition to the description provided above, this paper suggests additional areas for further investigation. It includes worker skills and training, performance measurement and problem solving techniques. The understanding of these areas may give a clearer indication and guidance towards becoming a stage 2 company.

6. Conclusion

The paper started off by highlighting the importance of providing support for manufacturing SME in becoming competitive. It follows with reviewing two types of MS framework and describing work around them. It is found the FSM by Hayes and Wheelwright (1984:396) are the most unique, in a way it shows dynamism – how operations progress from a neutral state to taking more proactive role or the other way around. The evidence in the literature shows there are many interests shown in examining the FSM using quantitative and qualitative methods, which includes its applicability to geographical locations, company size, cultural and environmental aspects. The paper found how positioning is improved along the FSM are one important questions that is left unanswered. Therefore suggesting the process to be examined in manufacturing SME by looking at how operations move from stage 1 to stage 2. This is because stage 2 is at the initial stage where improvement is made, while stage 1 is deemed most crucial stage where input is needed to avoid failure. Nevertheless, it can be a first step in building foundation to move up to the next stage. At the moment, a model is being built and tested to address the question. In order to complement this work, further research may explore the process taken by organisations to move from stage 2 to stage 3 and beyond as well as including large multinational as the sample size. It is also worth to look into the process in the context developing countries. Further it may be interesting to know how organisations can regress to lower stage upon achieving a higher stage.

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Biography

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