

Computer assistance to strategies

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Abstract

We describe the development of a decision support tool that aims to promote strategic flexibility in manufacturing firms by identifying competences for development. Particular attention is paid to the importance of information technology competences, especially with regard to some of the implications of our research for the future development of IT competences in UK manufacturing industry.

Key Words

Strategy, Flexibility, IT Competences, Decision Support Tool

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1 INTRODUCTION

The authors have undertaken a research project that has developed a decision support tool that aims to measure and to extend the potential of manufacturing firms to support evolutionary strategic change (Sharp et al., 1998).

The research project starts from the premise that the competences, technological, organisational, market, product and information technology, which the firm possesses, determine the strategies that it can pursue successfully. A corollary of this is that a firm that has a wide range of competences possesses *strategic flexibility*, i.e. it has a variety of strategies that it can follow successfully. As we shall see later, some strategies require more competences to be pursued successfully than do other, simpler strategies.

2 THE OBJECTIVES OF THE DECISION SUPPORT TOOL

In essence, the tool is intended to allow senior management to identify and evaluate future strategic paths at a broad brush level, in such a way that their analysis can be elaborated in much greater detail by functional managers. More specifically, there were a number of design objectives for the DSS, which we derived from our previous research.

- a) The DSS should be based on the notion of competences. Firms should be helped to identify existing competencies that needed improvement and new competences that, if acquired, would enable them to pursue other strategies;
- b) The DSS should be applicable to a wide variety of manufacturing industries;
- c) The DSS should not be overly prescriptive. It should, therefore, be presented in workbook format along the lines successfully pioneered by Neeley et al (1996) though the DSS would make use of computer support where required. Users should be given the opportunity to adapt the DSS to their own circumstances;.
- d) The DSS should be designed to cope with the different information requirements of Senior Management and Middle Management.

2.1 The Structure Of The Tool

To meet Objective d) the tool comprises two workbooks: a) a paper-based *Executive Workbook* for use by Senior Management, which is intended to be used by Senior Management to decide whether a more detailed study based on the *Full Workbook* is worthwhile; b) an electronic version (in Office 97), the *Full Workbook*, that works in considerably greater detail, which is intended for use by middle management This incorporates the *Executive Workbook* but allows users to carry out the detailed calculations required by means of **Excel** spreadsheets. Both workbooks allow users to:

1. Determine which competences need to be developed/enhanced in order to support the current strategies being followed by the firm;
2. Consider which strategies may be relevant in the future;
3. Examine the implications for competence development of these potential future strategies.

2.2 The Underlying Model

For our present purposes, the core model of the workbook is that the extent to which a particular competence is possessed is measured on a scale 0 - 100 (maximum) and the fit F_i of the **actual competences** possessed by the firm to the i th Strategy is given by:

$$F_i = \sum R_{ij}C_j \quad (1)$$

Where C_j represents the j th Competence Score, and R_{ij} is the matrix of Strategy/Competence Weights. The "Competence Gap" for the i th Strategy is then given by:

$$G_i = R_{ij} (100 - C_j) \quad (2)$$

Thus only strategies for which all needed competences, as represented by non zero values in the appropriate row of the Strategy/Competence Matrix, are fully present have a zero gap. In all other cases, the gap will be non-zero. Examination of the individual terms of Equation (2) makes it possible to reduce the value of G_i through judicious increases in the degree to which the firm possesses certain competences.

3 BUILDING THE TOOL

The crucial aspects of building the tool were:

- a) the construction of a typology of strategies of manufacturing firms;
- b) the identification of the competences required to support those strategies;
- c) the identification of the strengths of relationships between the competences and the strategies;

This required systematic research to derive the information required involving the use of both a National Survey and 32 carefully selected case studies (Sharp et al, 1998)

3.1 The Case Studies

The case study interviews were recorded and transcribed. The resulting transcriptions were analysed using NUD*IST (Gahan and Hannibal, 1997). For our present purposes, the final structure identified hierarchies of: competences and strategies.

3.2 Identification Of The Workbook Strategies

We developed the concept of a *Strategy Breakdown Structure*, i.e. a hierarchical breakdown of strategies into progressively more detail. This idea was attractive because a relatively modest breakdown could be used to provide the generic strategies to appear in the Executive Workbook, which could then be decomposed into more detail for the Final Workbook. Since both workbooks provide for firms to add strategies of their own, it was envisaged that if they wished to do so, it would be by further decomposing the strategies in a hierarchical way. The strategies identified through the NUD*IST analysis were used to decompose further a hierarchy based on a generic strategy classification suggested by Chrisman et al. (1988). Although our NUD*IST strategies were compatible with Chrisman et al's work, they represented a breakdown specific to manufacturing firms. Although broadly in line with the research of Miller and Roth (1994), they represent a distinctively UK based set of approaches to manufacturing strategy. There were 12 generic strategies identified for *UK Based Firms*, i.e. those operating essentially only in the UK, and 11 for *Global Firms*, i.e. those operating on a global basis.

Once they had been identified from the case studies, it proved possible to map the strategies into questions asked in the earlier National Survey for use in determining the Strategy/Competence matrix (R), as described below.

Table 1 - Breakdown of competences identified from the case studies.

Manufacturing	20	Procurement	9
Marketing	26	Product	17
Human Resource Management	21	Strategy	7
Financial/Accounting	10	Organisational	25
IT	36	Total	171

3.3 Identification of the Competences

The competences were identified using the NUD*IST analysis, as explained. Once this had been done suitable indicators of these competences were identified in the National Survey for use in the identification of the Strategy/Competence Matrix. The breakdown by business area of the 171 Competences identified is shown in Table 1

3.4 Estimation Of The Strategy/Competence Matrix (R)

Two approaches were combined to populate the UK Based strategy entries in the Strategy/Competence Matrix R.

- 1 The percentage of the firms following a particular strategy that used a particular competence was derived by cross correlating Strategies and Competences in the NUD*IST analysis.
2. Companies in the National Survey that were following a particular strategy were split into 3 groups: those a) that were unsuccessful, b) those that were very successful; and, c) those that were “stuck in the middle”. A Discriminant Analysis using Wilks’ Method was applied to companies in groups a) and b) using the Competence variables. The standardised Discriminant Function Weights were then rescaled to make the largest equal to 100.

Approach 1 identified considerably more non zero Strategy/ Competence weights than did Approach 2 but could not be used for every strategy because of a lack of case study instances. Both approaches were compatible with each other, i.e. two very different analyses based on two different research instruments had produced broadly similar results. It was therefore decided to combine the results of the two analyses using equal weights. The Strategy/ Competence weights for each method were, therefore added. The resulting weights were then rescaled so that the maximum value of any of the weights relating to a particular strategy was equal to 100.

Given the nature of the case study selection process (Sharp et al, 1998), both these approaches are essentially *Main Effects* based analyses. This fact was exploited to deal with the estimation of *Global Generic Strategies*. An additive **Global Strategy Addition** was estimated using Approach 2. The Global Generic Strategy Weights were then derived by adding the Global Strategy Addition to the weights for the corresponding UK Based Strategy weights.

4 STRATEGY EVOLUTION SCENARIOS

Examination of the Strategy Competence Matrix (R) showed that the successful pursuit of some strategies require many more competences than the pursuit of others. It is possible to discern a “logical” ordering of acquisition of competences to support progressively more complex strategies. The NUD*IST analysis of case study interviews suggested that there were a few typical routes by which companies evolved their strategies: to pursue an astrophysical metaphor, i.e. there are a few ‘main sequences’ down which the strategies of most manufacturing firms evolve. We were able to confirm this by undertaking a cluster analysis of the strategies followed by our National Survey firms to set up some revised strategic groups. These strategy groups were then mapped against the competence sets required to support them and sorted using a matrix clustering tool.

5 INFORMATION TECHNOLOGY COMPETENCES

As can be seen from Table 1, the largest single group of competences, over 20%, was comprised of IT competences. There was no particular bias towards IT competences in either our interview schedule or our mailed questionnaire. On the other hand, it was clear from our case study interviews that more straightforward Manufacturing Competences were to an extent taken for granted, as being essential to the survival of any manufacturing firm. Similar arguments probably also apply to the more basic competences in the other business areas. Certainly, what was apparent from the case studies is that mentions of competences reflected their salience to managers; these were competences that firms had had to acquire deliberately and with some effort. Thus, it seems a reasonable interpretation of the fact that IT Competences comprised the largest single group, that IT competences are of key importance to UK manufacturing firms. For reasons of space, we confine ourselves to the IT Competences associated with three of the global strategies: **Global Response**; **Global New Product Introduction**; **Global Product Functionality/Performance**, which our **Strategy Evolution Scenarios** show - occur early, midway and late on in the evolution of strategy. Because of our “main effects” approach to identifying the **Global Strategy Addition**, the results are similar for the corresponding UK Based strategies.

It is of interest to examine which are the most important IT Competences. There are two obvious ways to measure *Importance*: a) to identify those IT competences that are weighted close to 100 (the maximum possible value) for some strategies and sort the IT Competences in descending order of the maximum contribution they make to any strategy; b) to identify those IT Competences, that, on average, contribute most to the strategies. Those 15 IT competences with mean weights of at least 20 are displayed in Table 2 which is sorted in descending order of the average score.

5.1 Analysis of Table 2

The sophistication of the strategies listed, as measured by the number of different competences (all types) required to support them, increases from left to right in the table, as noted in the discussion of Strategy Evolution Scenarios. Corresponding to this, for most of the IT competences listed, the weights increase as we move from left to right. For these IT competences there is a straightforward interpretation that firms have to get better

at them as they move towards more sophisticated strategies. For the IT competences that do not show this pattern, e.g. **(Ability to) Run WANs**, it is worth remembering that the weights are partly based on mentions of the competence by case study firms. As was remarked earlier in respect of Manufacturing Competences, some competences may be so essential to a more sophisticated strategy that only a minority of respondents bothered to mention them.

With this comment in mind, we might expect the IT competences towards the top of the list as being the ones that preoccupied our manufacturing firms. The high standing of **Email** and **Internet capabilities** show the extent to which firms have had to grapple with the Internet. Competences such as **Ability to link computer systems** or **Ability to link direct to customer** are obviously important to firms operating on a global basis but represent rather more longstanding preoccupations. Given the difficulty of achieving them, it is not surprising to find them high on the list.

One of the issues for many of our firms was the move to generic software and PC based systems from the bespoke mainframe systems of a decade ago. This is reflected in the importance of two competences that are important in an era of generic systems that were not so in the past, e.g. **(Ability to) standardise hardware and software**, and, **(Ability to run) Integrated global information systems**.

Table 2 Mean Weights For Selected Competences For Three Global Strategies

Competence	Response to Customer Requirements	to New Product Introduction	Product Functionality/Performance	Mean
Email capability	20	64	100	61
Link computer systems	26	58	91	58
Internet capability	43	58	67	56
Link direct to customer	20	21	87	43
Use CAD/CAM	3	53	61	39
Standardise hw and sw	20	43	40	34
Integrate IS into firm	20	32	40	31
Use MRP2 effectively	20	21	46	29
Run WANs	11	43	29	28
Integrated global IS	11	43	29	28
Video conferencing	20	32	23	25
Ability to run LANs	14	21	35	23
EDI capability	17	21	23	21
Process drawing data	20	20	20	20
Link to suppliers	9	21	29	20

A number of the IT competences relate to hardware use. It is, perhaps, a little surprising to see the **Ability to run LANs** and the **(Ability to) Run WANs** receiving so much mention. Undoubtedly, this reflects the fact that for many Chief Information Officers the provision of effective network support is one of their major concerns, not least from the

perspective of Cost of Ownership. More intriguing, was the relatively strong interest in **Video Conferencing (Capability)** indicating that this technology, which is of obvious interest to the global firm, is finally coming to maturity.

Finally, we note that a number of manufacturing system related IT competences that have been longstanding preoccupations of firms are still of considerable importance, e.g. **(Ability to) Use CAD/CAM, Use MRP2 effectively, Process drawing data**. Given that we examined firms in a wide variety of manufacturing industries not all of which, e.g. process industries, need such IT competences, we can infer that the pursuit of CIM still presents difficulties!

6 CONCLUSIONS

Our research clearly indicates the importance of IT competences as strategy enablers. There is an argument that certain IT competences are so fundamental to globalisation that they have the status of **drivers** rather than **enablers**. Our analysis would seem to bear this out; the key IT competences that facilitate **global reach and range** were all revealed as main preoccupations of our firms following global strategies.

Confining ourselves to those at the top of the list (which interestingly apply potentially to all manufacturing firms) we may infer that the next frontier will be that of **Electronic Commerce**.

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