



A dynamic view on strategic resources and capabilities applied to an example from the manufacturing strategy literature

Andreas Größler

Industrieseminar, Mannheim University, Mannheim, Germany

Abstract

Purpose – The purpose of this paper is to demonstrate the usefulness of a dynamic analysis of the development and management of strategic capabilities and resources in manufacturing. It aims to present dynamic resource/capability systems as a means to understand an issue from manufacturing strategy.

Design/methodology/approach – A case study from a standard textbook on manufacturing strategy is used to illustrate the approach that is mainly based on Warren's strategy dynamics. Extensions to this approach are introduced.

Findings – Diagrams of dynamic resource/capability systems are valuable tools for understanding issues of interconnected and changing strategic resources and capabilities. Resources and capabilities can be interpreted as stocks in dynamic simulation models following ideas from system dynamics.

Research limitations/implications – The exact nature of strategic capabilities and their relationships needs to be further investigated. Approaches need to be developed to measure and to quantify these concepts. The connection between Hill's order winners/qualifiers and the inflows/outflows of capability and resource stocks should be further examined.

Practical implications – Static analyses of strategic issues are often difficult to interpret. The dynamic nature of strategic issues needs to be reflected in the tools used for analysing them.

Originality/value – Applies a dynamic analysis to manufacturing strategy and uses a textbook example in a new way to illustrate the relevance of the approach.

Keywords Strategic manufacturing, Dynamics

Paper type Case study

Although many authors acknowledge that strategic issues possess a dynamic nature, most approaches and methods in strategic management are inherently static. Therefore, in this paper the possibility is discussed to conduct a dynamic analysis applied to a problem from manufacturing strategy. More concrete, the purpose of this paper is to demonstrate the effectiveness of identifying dynamic resource/capability systems (Warren, 2002) when dealing with strategic issues in manufacturing. The paper exemplifies this based on a case study taken from a standard textbook on manufacturing strategy. With the help of the case, the value of a dynamic analysis following a strategy/system dynamics approach for strategic issues of manufacturing is established.

The manufacturing domain is a primary arena for discussing strategic resources/capabilities because of the important share it has regarding the value creation activities of firms that produce physical goods. Thus, an industrial company's



performance is substantially determined by the strategic resources it possesses and by the capabilities that can be derived from them. The application of these internal resources and capabilities to an external context of markets and competition is a critical factor contributing to the success of a company. Two issues are central to this concept, which are further explored in this paper: the strategic resources/capabilities of a firm build a system, i.e. they depend on each other, and this system changes, i.e. resources and capabilities develop and decay over time. One of management's major tasks is to plan and to control this dynamic process. Identifying and depicting dynamic resource/capability systems is a useful method to support management in this endeavour.

This paper is based on two research domains with which the author is familiar: system dynamics (Forrester, 1961; Sterman, 2000) and manufacturing strategy (Hill, 2000; Slack and Lewis, 2003). The paper is organised as follows: The next section briefly reviews the market and resource-based perspectives on strategy. Then, different understandings of strategic resource/capability systems are described and it is discussed why a dynamic perspective seems inevitable. After that, an example shows how a dynamic view on resources and capabilities can significantly improve understanding of complex situations in manufacturing strategy. For this purpose, a case study is presented together with a market-based solution. This solution is then amended using a dynamic perspective, paying particular attention to the resource/capability system of the case company. This paper closes with an integration of ideas from market and resource-based views in a comprehensive dynamic system of corporate resources and capabilities.

Market versus resource-based view

The necessity for developing a comprehensive strategy has been emphasised by many empirical studies. For instance, the well-known PIMS project resulted in the insight that about 70 per cent of the differences in the variance of return on investment between successful and unsuccessful companies can be attributed to strategic factors (such as market share, quality, vertical integration, and innovations). Only about 30 per cent can be linked to differences in operational efficiency (Buzzell and Gale, 1987; for a similar notion see also Skinner, 1986). Based on the evidence supporting the general usefulness of strategies, many approaches to strategy making and implementation can be identified (Mintzberg *et al.*, 1998, present ten "schools" of strategy; Cummings and Wilson, 2003, speak of 13 "images" of strategy). For reasons of brevity, in this paper only two important approaches to strategic management, on both the corporate and the functional levels (for instance, in manufacturing strategy), are further discussed: the market-based and the resource-based perspective.

Market-oriented strategy development analyses the company from an external perspective. Performance is expected to depend primarily on the market situation. Based on the "structure-conduct-performance" paradigm, performance and competitive behaviour are driven by the market structure (Bourgeois and Astley, 1979). Profits are the result of either advantageous competitive situations or restricted competition (e.g. monopolies). Strategies are formulated following a comprehensive analysis of the environment. Although the "relevant" environment is comprised of many domains (including economic, technological, environmental and social issues), the most important domain for a company from the market-based perspective is the industry in which it competes.

A company's success – argued from a market-based perspective – is a function of the effect of competitive forces, which result from industry specifics. Porter (1980) describes five forces, which can be examined in an industry structure analysis: level of rivalry in the industry, bargaining power of customers, bargaining power of suppliers, threat of new entrants and threat of substitute products. By evaluating all five determinants, the current strategic position as well as future opportunities and risks can be investigated.

Although the market-based perspective serves as an essential step in strategic analysis, it is limited. For example, it does not provide satisfactory answers to crucial questions like “What characteristics should a firm possess in order to achieve a leading position within an industry?” and “What features does a firm need to defend a market position?” questions which are critical in dynamic, turbulent markets (SubbaNarasimha, 2001). The idea that a firm's competitive position within an industry significantly depends on the company's internal strengths and weaknesses is not considered in a market-oriented strategy development approach (Teece *et al.*, 1997). This appears to be a significant short-coming of the market-based perspective because, for instance, Rumelt (1991) shows that the success of a firm is to a substantially bigger share influenced by its internal and firm-specific assets than by characteristics of the industry in which the firm competes.

The resource-based perspective holds as a main principle that the success of organisations is only secondarily determined by the position in the market. From this “resource-conduct-performance” perspective, the primary determinant of success is the bundle of resources and capabilities that characterises an organisation (Wernerfelt, 1984; Penrose, 1959; Selznick, 1957). Strategic resources are those resources that are necessary to achieve and defend market positions, i.e. resources can only be considered strategic if they are perceived at the marketplace by customers and/or competitors. Strategy development, from a resource-based perspective, is characterised by a continuous assessment of the possibilities to apply these resources and the capabilities resulting from them to changing environments (Mahoney and Pandian, 1992) and to focus management's attention on these resources that are necessary for success (just growing all resources is inefficient; Mishina *et al.*, 2004).

Resources[1] are assets which a firm possesses, controls or to which it has access. Resources make it feasible for an organisation to achieve its goals. It is possible to distinguish between tangible (for instance, customers, staff, or production capacity) and intangible resources (for example, image, corporate culture, or specific skills). Intangibles frequently can be found coupled with tangibles (for instance, number of staff coupled with level of staff experience). Intangible resources are usually more difficult to measure and to manage than tangible resources – for instance, the process of building up customer loyalty is a long-lasting challenge.

Capabilities are modes of behaviour that an organization is able to perform in order to support its strategy. In contrast, to resources – something that a firm has, capabilities are activities – something a firm is good at doing (i.e. a kind of “procedural knowledge” of an organisation; Anderson, 1983). Usually, a company needs resources to be able to take advantage of its capabilities. A firm's capabilities are created by the complex interaction of its resources combined with implicit or explicit knowledge about the effective combination of these resources (Amit and Schoemaker, 1993).

Based on these capabilities, input factors to a production process are transformed (literally or metaphorically) into products and services (Warren, 2002).

The relationship between resources and capabilities is a primary object of interest in strategy development following a resource-based view (Grant, 1995). While strategic capabilities are always built upon one or more resources, a firm can possess strategic resources that are not related to a capability. In other words, behaviour modes of a firm rely on the internal assets the firm has and on their effective combination; however, these internal assets can be strategic in nature (i.e. they are relevant regarding the strategic goals of a company) without being linked to one or more capabilities. This usually is the case when the sheer possession of a resource makes a difference in competition or when a resource directly translates into a performance measure of the organisation. In addition to that, strategic resources might be important for more than one strategic capability to come into existence. For instance, the resource “skilled workforce” adds to a capability to produce high quality as well as to a capability to quickly change production programmes.

More recently, the resource and capability-based perspective of strategy has also been applied to issues of production and operations management (Ketokivi and Schroeder, 2004; Schroeder *et al.*, 2002; Swink and Hegarty, 1998; Bates and Flynn, 1995). The basic proposition of most of these papers is that resources and capabilities depend on each other and both determine performance (as shown in Figure 1).

However, discussions frequently fail to address two issues concerning the idea of resource-based strategy development (Sanchez and Heene, 1997). Firstly, the strategic resources and capabilities of a firm build a system, which means that they depend on each other and affect each other. These dependencies might establish feedback loops, so that resources and capabilities ultimately influence themselves. Secondly, systems of resources and capabilities are not stable over time, meaning that resources and capabilities develop and decay dynamically and their relationships change. Thus, the dynamics of each resource and each capability as well as the dynamic and complex interaction between them can be influenced and must be managed[2]. This paper deals with these issues by offering a more in-depth discussion of the dynamics of resources and capabilities. For that end, a case study is presented that shows how a dynamic view on resources and capabilities can provide substantial insights into a problem from manufacturing strategy.

The systemic and dynamic nature of strategic resources and capabilities

The classical, linear perspective of the relationship between resources, capabilities, and performance is shown in Figure 1. From a systemic point of view, however, this picture needs to be enhanced with regard to two important points. Firstly, it should be made clear that strategic resources and capabilities influence other resources and capabilities and – frequently via some intermediate variables – themselves. An example of this is a dependency that can be observed between pairs of tangible and intangible resources.

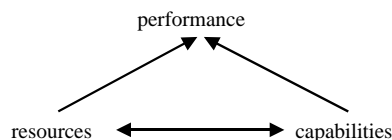


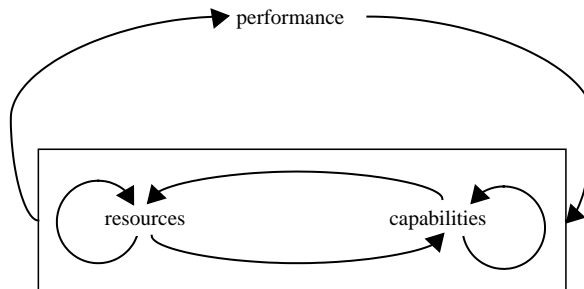
Figure 1.
Relationship between
resources, capabilities and
performance (linear view)

For instance, the two strategic resources “number of staff” and “staff experience” are related to each other. Thus, adding more staff to a company’s workforce reduces average staff experience because new staff often does not possess the necessary skills already from the start; but, in the long run, it allows elevation of “staff experience” to new heights when new staff is fully trained and when it is adding its talents to existing knowledge (Morecroft, 2002). An example of a strategic resource that directly influences itself is the customer base of a firm competing in a market with strong positive demand externalities. For example, in the market for instant messaging services (Größler and Thun, 2002), having a large customer base attracts more potential users for the product as well, thus, enlarging the existing customer base. Of course, this network effect, a positive feedback loop, is limited by the total number of potential customers and eventual market saturation.

A second enhancement that can be added to Figure 1 is a feedback relationship between performance on one side and resources and capabilities on the other. Besides, the fact that strategic resources and capabilities influence the performance of an organisation (otherwise, they would not be strategic) a reciprocal process exists: the company’s performance also affects its resources and capabilities. An example of this is the connection between the capability to produce with high product quality and sales revenue as a performance indicator. Producing with high quality (among other factors) influences sales, which determine sales revenue. However, sales revenue also determines how much effort (concerning money and time) can be put – *ceteris paribus* – into the further improvement of the product quality capability, at least in the long run. Taking these two modifications into consideration, an enhanced version of the relationships between resources, capabilities and performance can be derived (Figure 2).

The understanding of strategic resources besides their relationships to capabilities and performance can be improved as well. In the literature, it is argued that a strategic resource should have four main characteristics (Peteraf, 1993; Mahoney and Pandian, 1992; Barney, 1991; Wernerfelt, 1984). It should be:

- (1) durable: has a long-lasting positive effect on the strategic position of a firm;
- (2) non-tradable: not possible for competitors to easily buy it;
- (3) non-replicable: not possible for competitors to easily duplicate or copy it; and
- (4) non-substitutable: not possible for competitors to easily find a substitute for it.



Note: There are more determinants to an organisation’s performance than its resources and capabilities, for instance, market characteristics, competitors’ behaviour, political and societal developments

Figure 2.
Feedback view of
resources, capabilities and
performance

The features in this list imply that resources can be used to build “entry barriers” around a market, because either a firm has them (then it has the potential to be a market player) or it does not have them (then it is essentially locked outside the market).

However, it is myopic to assume that strategic resources, identified by a company using a resource-based approach, can ensure impenetrable entry barriers. As economic history shows, successful market entries of firms have happened many times. The entrants usually only had resources to a limited degree available. Therefore, resources are probably not so much entry barriers around a market but “useful things to have” in order to compete in a market. Thus, despite the appeal of the four characteristics, they hinder the full exploitation of the resource-based view for “strategizing” (Eisenhardt and Martin, 2000) because these assumptions assume that performance results from scarce resources instead from new combinations of resources for new opportunities (Schumpeterian rents; Mollona, 2002).

From a dynamic point of view, categorically sticking to the four characteristics causes three major issues (Warren, 2002):

- (1) Resource characteristics occur along a continuum rather than being absolute. In other words, “very few resources are totally durable, absolutely non-tradable, or totally impossible to copy or substitute” (Warren, 2002, p. 18); rather they show some elasticity regarding these characteristics (Makadok, 2001).
- (2) Resources need to be maintained or given up; they are made obsolete, are copied or substituted. None of this can be achieved in zero time; it is a dynamic task. How long it takes to build up or destroy a resource and what delay times need to be considered are important questions. The usual definition of strategic resources does not consider this dynamic nature.
- (3) Resources are often interrelated (as already mentioned above). Furthermore, the relationships between resources might change over time depending on past or current resource configurations, external disturbances, path dependencies or management decisions. The static view neglects these structural and behavioural changes.

In spite of the issues connected with understanding resources in a static fashion, the identification of resources builds the starting point of every resource and capability based strategic analysis[3]. Therefore, it is also used in the example presented in the next section. Later on, however, the static view is improved and extended using ideas from dynamic methodologies, in particular system dynamics (Forrester, 1961; Sterman, 2000).

Applying a dynamic resource and capability view to a case from manufacturing strategy

This section applies the dynamic resource-based view of strategy as outlined by Morecroft (1997) and Warren (1999) to a typical case from manufacturing strategy taken from a standard textbook on the topic (Hill, 2000). In extension to Morecroft’s and Warren’s initial approach some more emphasis is put on conceptually differentiating between resources and capabilities. Following this procedure, it is demonstrated that a dynamic view of resource systems (i.e. focussing on strategic resources) can be augmented and simplified rather straightforward by the simultaneous consideration of

strategic capabilities. However, from a practical point of view both, strategic resources and capabilities are treated very much alike, namely as stocks in a dynamic system.

In the first sub-section, the case is presented. Additionally, the “conventional” market-based solution – as provided by Hill – is discussed. It follows a static resource-based analysis of the situation, i.e. the identification of resources, capabilities and performance measures. Then, this static analysis is modified by a dynamic perspective on strategic resources and capabilities.

Case presentation and market-based analysis

The case that is used as an example in this paper is “Jackson Precision Castings (JPC)” taken from Hill (2000, pp. 348-63). As most case studies, the JPC case consists of qualitative and of quantitative information. Both types of information are used in the following discussion of the case and in the application of a dynamic resource perspective. Wherever numerical values are given, they are derived from or estimated based on the case narrative.

In summary, JPC produces die-castings for the European market; annual sales revenue is 19.8m. Market research (visiting five major customers) led to three conclusions, which are presented in the case narrative:

- (1) the market is becoming less price-sensitive;
- (2) the firm should try to increase market share in the well-established UK market; and
- (3) sales in Europe should be expanded.

Based on further information acquired during the market study, JPC’s management decided to implement a continuous improvement programme (CIP) and a new incentive scheme. The CIP established four key areas for possible improvement: manufacturing methods, administrative systems, set-up time, and quality. The new incentive scheme consisted of new standard times to be used, the introduction of group related payments, and the offer of a bonus payment linked to output numbers. The goal – as formulated in the beginning of the case – is to achieve increased sales and profitability with the help of the CIP and the incentive scheme.

Hill’s approach to manufacturing strategy is primarily a market-based one, which has been criticized (Slack *et al.*, 2001). The analysis of the case, as suggested by Hill (2000) in the teaching notes to his textbook, is based on his order winner/qualifier paradigm. This concept says that, from a strategic perspective, products/services are characterised by two types of features. The first type of features is necessary for the product/service to be perceived and considered by potential clients (“qualifiers”); features of the second type are necessary to actually gain customers’ orders (“order winners”).

In the JPC case, information about order winners and qualifiers is mainly deducted from the reports about the customer visits. When comparing these order winners and qualifiers with what is supported by the CIP and the incentive scheme, it was revealed that the intersection is rather small. Market analysis showed that the major order winner for nearly all customers is fast delivery time and/or delivery reliability. These, however, are neither heavily supported by the CIP nor by the new incentive scheme: only one out of four target areas of the CIP deals with time (“set-up time reduction”); fast and reliable deliveries are not included as a factor in the new incentive scheme at all.

As a result, incentives do not support the company's goal of increasing sales revenue (Kaufman, 1992). Summarising this finding it can be stated that significant problems can be expected in achieving the business objectives of growth because the programmes initiated in the company do not support what is really needed to attract additional orders. Furthermore, the case emphasises the importance of time as a strategic factor (Milling *et al.*, 2000; Stalk and Hout, 1990; Blackburn, 1990).

Identification of resources, capabilities and performance measures

A static analysis of the case helps to identify resources, organisational capabilities and performance measures. However, only identifying these objects does not provide all the insights necessary to tackle the problem and suggest a solution. Rather, a static analysis of – as it will be turn out – a dynamic problem can only be a first step of a solution. Nevertheless, the static analysis that is presented in this sub-section sets a boundary on the scope of the preceding dynamic analysis.

For a beginning, performance measures are simply derived from the problem statement raised in the beginning of the case narrative: sales and profit. If it is assumed that:

$$\text{Profit} = \text{Sales} - \text{Costs},$$

the list of performance measures can be adjusted in a way that not both factors are necessary to consider:

- (1) *Either*. Costs are believed to be fixed and not changeable within the time horizon of the case setting. In this case, sales would be sufficient as a performance indicator.
- (2) *Or*. Sales and costs can be influenced and then both should be relevant performance measures. Under these circumstances, profit can be calculated directly and does not really need to be considered as a strategic goal.

Because the case contains the information that the market is not very price sensitive and the case narrative does not give precise data about the cost situation, costs are neglected in the further analysis and only possibility (1) is considered in the following, resulting in sales as the relevant performance indicator.

Based on the continuous improvement programme and the incentive scheme the following list of capabilities seem to be important for the management of JPC:

- producing with high quality conformance of products (measured in percentage of products without defect; quality);
- producing with high productivity, i.e. little costs per unit (measured in standard hours produced compared to actual hours worked; productivity); and
- producing with short lead times and delivery times (measured in delivery time and average on-time delivery; time).

In addition, there is one strategic resource referred to in the case description:

- order base (measured in monetary value; order base).

The question remains how these capabilities and resources can be managed in order to increase performance. A systemic and dynamic view on the resources and capabilities helps to better understand this issue.

Dynamic analysis of resource and capability system

The resources, capabilities and performance measures identified in the last sub-section are put into a dynamic framework based on Warren's (1999) approach of dynamic resource systems. The basic mathematics of the method are discussed in Warren (2002, Appendix). His method is heavily influenced by the system dynamics concept, developed by Forrester (1961). Some characteristics can be considered crucial for this approach:

- Feedback loops are regarded as building blocks of all economic and social systems because mono-causal reasoning abstracts too much from reality. Two types of feedback loops can be distinguished: positive (or reinforcing) loops and negative (or balancing) loops. Feedback loops often cause nonlinear behaviour of the system in which they are present.
- There are stocks (or levels) in every system that accumulate past system's behaviour. Mathematically, stocks can be understood as integrations. They can only be changed by corresponding flows; often, this process is influenced by delays.
- Qualitative or "soft" variables are not omitted from analyses but estimated as accurately as possible because omitting them would definitely cause an error.

Based on Dierickx and Cool (1989), strategic resources are represented as stocks in Warren's dynamic resource-based view. Managing resources therefore means to change them by influencing the corresponding rates. Various connections that sometimes create feedback loops exist between resources and their rates. Resources are often intangible, i.e. "soft" factors that are included in the analysis.

However, Warren's approach goes further than just picturing the connections between resources and performance indicators. Every connection symbolizes not only the fact that one object is the cause of another; but it also says that the value of one object can be calculated from the value of the other and demands the definition of measurement scores. Furthermore, dimensional units, ranges of numerical values and estimated behaviour modes are attached to important variables. The dynamic resource/capability system for the JPC case is shown in Figure 3, which is a graphical description of the strategic resources and capabilities and their interconnections.

In Warren's (1999) original approach, rectangles symbolise stocks of strategic resources only. However, in this paper it is proposed that they more logically represent either resources or capabilities. For instance, the quality stock in Figure 3 can be understood as the capability "producing with high quality conformance of products". The inclusion of strategic capabilities in the diagram has two advantages:

- (1) In the case description, there are direct references to capabilities, not to resources. This means that the resources that actually make up a capability have not to be known or guessed when capabilities are directly incorporated in the diagram. This advantage might become a disadvantage if the underlying resource set of a capability needs to be addressed, which is not the matter in the case presented here.
- (2) The influence of, for example, quality on the order base becomes clearer than directly from the corresponding resource. Of course, there are resources linked to the quality capability, like "employees' willingness and ability to produce high quality products'. However, not the nature of this resource itself leads to a change in order base but the capability of the manufacturing system to produce with a certain, expected standard.

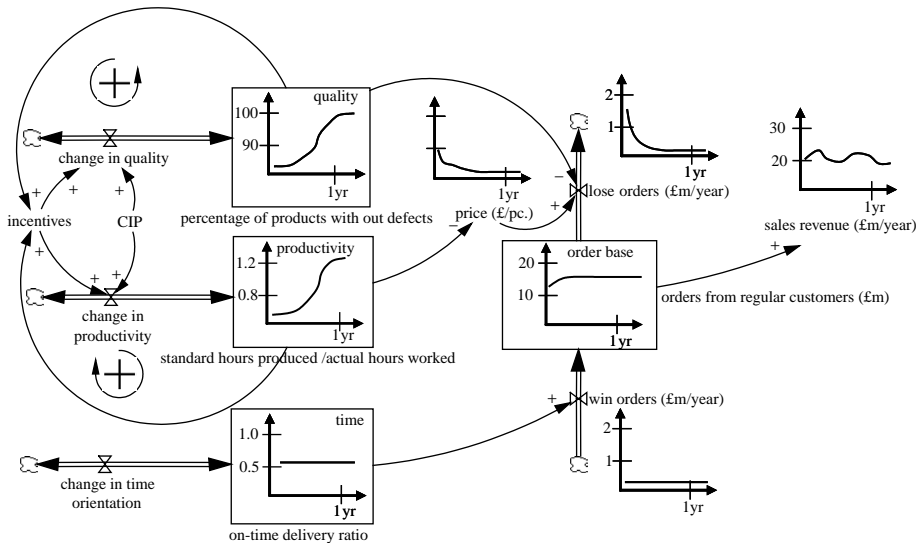


Figure 3.
Dynamic
resource/capability system

Measures and possible behaviour paths of resource/capability stocks are depicted (actual behaviour is discussed below). Double arrows and valve symbols represent rate variables that can be used to change stocks. A single arrow stands for the possibility to calculate the value of one variable by the value of another. Feedback loops are specifically indicated: “+” for positive, reinforcing loops; “-” for negative, balancing loops (not occurring in the example).

The identification of resources and capabilities is described in the sub-section before. Thus, in Figure 3, four stocks are shown. The three capabilities at the left side influence the resource order base, which is the fourth stock variable in the diagram. Order base directly determines sales revenue that is the performance indicator in the case. Because they are stocks, resources and capabilities can only be changed through their corresponding rates: for instance, a loss of orders is triggered by quality problems or too high costs; gaining orders is accomplished by high dependability of deliveries. Note that in order to simplify the diagram only such influences on variables are depicted that matter in this specific case. For instance, building up production capacity might increase the on-time delivery ratio and thus change the time capability of JPC. However, such a measure is nowhere discussed in the case description and therefore not considered in this analysis (and not included in the diagram). Dimensional units are only given for variables on the right hand side of the graph because variables on the left are either dimensionless (as the three capability stocks) or of pure abstract nature (as, for instance, the incentives or CIP variables)[4].

The fundamental problem of the case situation is made obvious in the rate structure changing the quality, productivity, and time capabilities. While management activities based on the continuous improvement programme or the new incentive scheme positively influences quality and productivity, there is hardly any action undertaken that aims at increasing the time orientation of the company. In other words, the time capability (producing with short lead times and delivery times) is not improved, neither directly nor through its underlying resources. In contrast, to this, the new incentive

scheme together with quality and with productivity builds a reinforcing loop that further drives their growth: for instance, the incentive scheme leads to more consideration of quality aspects by the employees which leads to less defective products which leads to higher incentives further fuelling the production of non-defective products (Senge, 1990). Unfortunately for JPC, from the case analysis can be induced that quality and productivity are qualifiers only, i.e. their existence just hinders a loss in orders. To gain orders, an order-winning factor is needed, which is time in the JPC case.

What happens in this setting is depicted in the small behaviour graphs shown in the figure. Note that all graphs show dimensions and scales for the associated variables (all numerical values are deducted from the case narrative; however, some are estimates because the case did not provide detailed data). Both, quality of products and productivity of process are increased by the action programmes and the reinforcing feedback loops they initiate, which results in a declining loss of orders. Time orientation is constant and, thus, on-time delivery ratio hardly changes. This leads to a constant, but approximately zero gain in new orders. In total, the size of the order base shows only negligible change. The sales revenue also has minimal growth (except for some seasonal or random fluctuations), which is in contrast to the objective of JPC's management.

Much better than the verbal, market-based analysis presented above, this picture of the dynamic resource/capability system visualises the issue at hand. Leverage points can be identified quite easily, lying in the change rates of those resources that prominently influence performance. What needs to be done in this case is rather simple to see now: a mechanism is needed that drives growth of time orientation, which as an order winner would result in gaining more orders, an increased order base and, ultimately, more sales. The dynamic resource/capability system can serve as a base for a scenario analysis (Wack, 1985): the effects of certain changes at some of the resources can be mentally simulated. The graph ascertains that all relevant interdependencies are considered and that assumptions about their nature are made explicit.

A more favourable behaviour path of the system is shown in Figure 4 (as in the figure before, the resulting graphs are mentally deduced from the structure of the resource/capability system). By inclusion of on-time delivery ratio as a factor on which incentives are based, time now also grows. In this situation, the incentive scheme and time build a positive, reinforcing loop that allows for growth. This leads to substantial gains in orders and an increase in order base. Finally, sales revenue grows as well.

Some remarks concerning the method of examining dynamic resource/capability systems conclude this section:

- For a more detailed analysis, capabilities and their constituting resources could also be investigated separately (for instance, the capability "producing with high quality conformance of products" might be built upon "employees" willingness and ability to produce "high quality products" "accuracy of production system" and "high quality suppliers" as strategic resources). In this way, the interplay of different resources that result in strategic capabilities can be examined and more fine-grained policies can be tested. In order to simplify the graphical representation, to stick close to the case description, and because it does not change results, in this paper this path is not taken. Instead, capabilities are examined as an aggregate of all the resources that are their constituents.

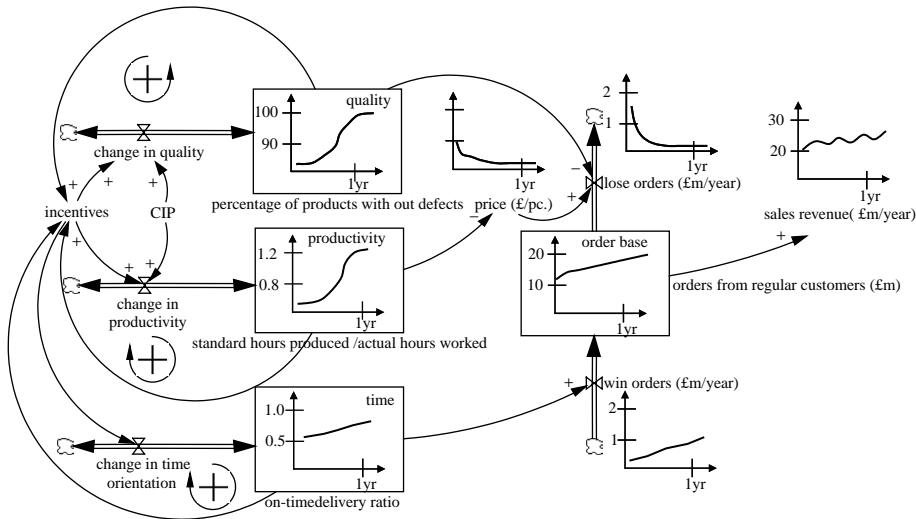


Figure 4.
Dynamic
resource/capability system
with favourable behaviour

- The decay of capabilities and resources over time is deliberately not included. However, in reality most capabilities and resources decrease if they are not actively managed. For instance, product quality deteriorates if no active measures are taken, like motivating staff to take care of quality, improving processes to secure quality, etc.
- Sales as a performance measure might itself influence resources and capabilities (this kind of feedback was discussed above). Furthermore, it is conceivable that additional linkages exist between variables in the diagram (for example, an effect from quality to CIP). However, because the case does not report on these effects, they are neglected. In real-world projects, such conceivable but not depicted relationships imply the necessity of further empirical investigations.
- From a system theoretic point of view, s-shaped growth (as for example, depicted in the quality capability) cannot occur by a reinforcing feedback loop alone. Always an additional balancing feedback loop is necessary that limits the infinite growth of the positive loop (in the example, percentage of products without defects cannot be bigger than 100 per cent; when approaching this limit it becomes ever more difficult to improve further).
- In the diagrams, it becomes apparent that resource-based analyses as understood in this paper do not neglect characteristics of markets, competition, customers, etc. Rather the approach emphasises a mutual dependency between external and internal perspectives on strategy. For instance, customers' behaviour concerning ordering serves as a fundamental input to the diagram.

Perspectives of integrating market and resource-based analyses

As a practical implication of this research, managers should be warned that static analyses of strategic issues are often difficult to interpret or even misleading. The dynamic nature of strategic issues needs to be reflected in the tools used for

analysing them, as for instance, diagramming resource/capability systems offers a way to take into account the dynamic nature of manufacturing strategy. As was shown, analysing the dynamic resource and capability system is an intuitive but powerful method to symbolise dependencies and time paths of strategic factors. Cause-and-effect relationships are observable, feedback loops can be identified and potential system behaviour can be deduced. Furthermore, the system of dynamic resources and capabilities helps to build different scenarios of future behaviour modes of the system. In this way, the dynamic resource and capability system is a valuable tool to support management learning through planning and scenario-building processes (De Geus, 1988). Through an iterative process of scenario planning, evaluation of outcomes and changing of policies, insights into the dynamic nature of organisations and markets can be acquired. Owing to the quantitative component of the approach (dimension and scale of variables), also rough prognoses concerning the development of important performance variables are possible.

Despite all these advantages, there is a discrepancy to be discovered between the claim to depict dynamic resource systems and the method, how this is done. Resource systems drawn on paper are inherently static. In other words, the dynamics they possess must be imagined in the mind of the user. There is substantial evidence that these cognitive processes often are biased and are prone to systematic failures (Frensch and Funke, 1995). The thinking and decision processes of individuals are only bounded rational (Simon, 1979). Particularly the dynamic behaviour of connected variables building feedback loops is difficult to estimate (Forrester, 1994). Individuals have difficulties in dealing with complex systems, for instance when they have to estimate nonlinear behaviour modes (Dörner, 1980). It can be assumed that the graphical and structured depiction of the system mitigates this danger, but this approach does not completely prevent it from occurring. Simulating the system's behaviour with the help of simulation software therefore comes as a logical extension to the approach discussed here[5].

Thus, a rather natural step for dynamic resource/capability systems would be to develop them with the help of computer simulation software. In particular, programmes to build and simulate system dynamics models seem appropriate because:

- the dynamic resource-based view stems from this methodology; and
- there exist some well-tested and established application programmes[6].

When defining dynamic resource systems in such an application, it is very easy and straightforward to simulate their behaviour. With the support of simulation programmes, many different scenarios can be tested by varying parameters and functions. Methods like sensitivity analysis and optimisation algorithms can be used to further investigate the behaviour of the resource/capability system (for instance, to identify critical points or limitations). By conducting many of such simulation experiments (over long time horizons), learning can be more effective than when drawing the dynamic resource system on paper only (Pidd, 1993). In addition to that, through the even more rigid formalisation and quantification processes all assumptions are open and can be discussed (Vennix, 1994). However, this quantification process is not a trivial one; further research concerning the measurement and quantification of such abstract concepts as strategic capabilities and resources (particularly when they are intangible) is needed.

The case presented above also shows an interesting way to integrate market and resource-based strategic analyses. There is a close connection between Hill's order winner/qualifier concept and Warren's dynamic resources. As can be seen in Figures 3 and 4, those capabilities that were identified as qualifiers by Hill (productivity and quality) influence the deterioration process of the order base that directly determines the performance variable, sales revenue. Put in a different way, resources that are qualifiers cannot help to increase market or customer variables; they only hinder that they decrease. In contrast to that, the order winning capability time helps to grow performance variables. Future research needs to focus on this issue in order to identify and to establish more links between market-based analysis and dynamic resource/capability systems. More generally, the exact nature of strategic capabilities and their relationships needs to be further investigated. This should include the development of approaches for measuring and quantifying these concepts.

Notes

1. In this paper, unless otherwise stated the term "resource" always means "strategic resource", i.e. a factor that is responsible for the current and future success of a company in the marketplace, not just something that is needed in order to fulfil a company's regular operations. In a similar vein, "capability" always stands for "strategic capability".
2. The effective management of resource and capability systems can be seen as a strategic capability as well, thus suggesting different levels of abstraction regarding capabilities and complex interactions between these abstraction levels (Mollona, 2002).
3. Strategic analyses following a market-based approach are usually bounded to a static view as well. For instance, the well-known market growth/market share portfolio is a static instrument in the way that it depicts a current and (sometimes) a desired, future state of strategic business units (Henderson, 1979). The dynamics incorporated in the origins of the portfolio (i.e. product life cycle and experience curves) are only implicitly taken into account. For a dynamic view on market-based strategy, see Markides (1999).
4. This approach deviates from conventional system dynamics practice and lacks methodological rigour. Additionally, a strict analysis of unit consistency between variables would indicate missing variables or mis-specified units (for instance, order base with unit £m directly results in sales revenue with unit £m/year). However, for the sake of a clear presentation of the case and the method – and because the resulting solution does not differ – these simplifications were chosen to be acceptable and appropriate in the context of this paper.
5. These issues are also briefly discussed by Warren (2002). However, he does not put special emphasis on the involved quantification and the mathematical formulation process in his writings.
6. Three commercial software packages to build system dynamics models exist: Vensim, Powersim and iThink/Stella. All of them are descendants from the dynamo programme that was used by Forrester and his colleagues when they established system dynamics in the 1960s. Besides that, a specific software programme (myStrategy) concentrates on mapping and simulating dynamic resource systems.

References

- Amit, R. and Schoemaker, P.J.H. (1993), "Strategic assets and organizational rent", *Strategic Management Journal*, Vol. 14, pp. 33-46.
- Anderson, J.R. (1983), *The Architecture of Cognition*, Harvard University Press, Cambridge, MA.

- Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120.
- Bates, K. and Flynn, J. (1995), "Innovation history and competitive advantage: a resource-based view analysis of manufacturing technology innovations", *Academy of Management Journal, Best Paper Proceedings*, pp. 235-9.
- Blackburn, J.D. (1990), "The time factor", *National Productivity Review*, Vol. 9 No. 4, pp. 395-408.
- Bourgeois, L.J. and Astley, W.G. (1979), "A strategic model of organizational conduct and performance", *International Studies of Management and Organization*, Vol. 9 No. 3, pp. 34-66.
- Buzzell, R.D. and Gale, B.T. (1987), *The PIMS Principles – Linking Strategy to Performance*, The Free Press, New York, NY.
- Cummings, S. and Wilson, D. (2003), *Images of Strategy*, Blackwell, Malden, MA.
- De Geus, A.P. (1988), "Planning as learning", *Harvard Business Review*, Vol. 66 No. 2, pp. 70-4.
- Dierickx, J. and Cool, K. (1989), "Asset stock accumulation and sustainability of competitive advantage", *Management Science*, Vol. 35 No. 12, pp. 1504-11.
- Dörner, D. (1980), "On the difficulties people have in dealing with complexity", *Simulation & Games*, Vol. 11 No. 1, pp. 87-106.
- Eisenhardt, K.M. and Martin, J.A. (2000), "Dynamic capabilities: what are they?", *Strategic Management Journal*, Vol. 2, pp. 1105-21.
- Forrester, J.W. (1961), *Industrial Dynamics*, MIT Press, Cambridge, MA.
- Forrester, J.W. (1994), "Policies, decisions, and information sources for modeling", in Morecroft, J.D.W. and Sterman, J.D. (Eds), *Modeling for Learning Organizations*, Productivity Press, Portland, OR, pp. 51-84.
- Frensch, P.A. and Funke, J. (Eds) (1995), *Complex Problem Solving – The European Perspective*, Erlbaum, Hillsdale, NJ.
- Grant, R.M. (1995), *Contemporary Strategy Analysis: Concepts, Techniques, Applications*, 2nd ed., Blackwell, Cambridge, MA.
- Größler, A. and Thun, J.H. (2002), "Policies influencing the diffusion of instant messaging", *Proceedings of the 20th International Conference of the System Dynamics Society, Palermo*.
- Henderson, B.D. (1979), *Henderson on Corporate Strategy*, Abt Books, Cambridge, MA.
- Hill, T. (2000), *Manufacturing Strategy: Text and Cases*, 2nd ed., Palgrave, Basingstoke.
- Kaufman, R.S. (1992), "Why operations improvement programs fail: four managerial contradictions", *Sloan Management Review*, Vol. 34 No. 1, pp. 83-93.
- Ketokivi, M. and Schroeder, R. (2004), "Manufacturing practices, strategic fit and performance: a routine-based view", *International Journal of Operations & Production Management*, Vol. 24 No. 2, pp. 171-91.
- Mahoney, J. and Pandian, J.R. (1992), "The resource-based view within the conversation of strategic management", *Strategic Management Journal*, Vol. 13, pp. 363-80.
- Makadok, R. (2001), "Toward a synthesis of the resource-based and dynamic-capability views of rent creation", *Strategic Management Journal*, Vol. 22, pp. 387-401.
- Markides, C.C. (1999), "A dynamic view of strategy", *Sloan Management Review*, Vol. 40 No. 3, pp. 55-63.
- Milling, P., Schwellbach, U. and Thun, J.-H. (2000), "Time as a success factor for operations management", in Van Dierdonck, R. and Vereecke, A. (Eds), *Crossing Borders and Boundaries: The Changing Role of Operations*, Academic Press Scientific Publishers, Ghent, pp. 431-8.

- Mintzberg, H., Ahlstrand, B. and Lampel, J. (1998), *Strategy Safari: A Guided Tour through the Wilds of Strategic Management*, The Free Press, New York, NY.
- Mishina, Y., Pollock, T.G. and Porac, J.F. (2004), "Are more resources always better for growth? Resource stickiness in market and product expansion", *Strategic Management Journal*, Vol. 25, pp. 1179-97.
- Mollona, E. (2002), "A competence view of firms as resource accumulation systems: a synthesis of resource-based and evolutionary models of strategy-making", in Morecroft, J.D.W., Sanchez, R. and Heene, A. (Eds), *Systems Perspectives on Resources, Capabilities, and Management Processes*, Pergamon, Amsterdam, pp. 93-125.
- Morecroft, J.D.W. (1997), "The rise and fall of people express: a dynamic resource-based view", in Barlas, Y., Diker, V.G. and Polat, S. (Eds), *Systems Approach to Learning and Education into the 21st Century, Proceedings of the 15th International System Dynamics Conference, Istanbul*, pp. 579-86.
- Morecroft, J.D.W. (2002), "Resource management under dynamic complexity", in Morecroft, J.D.W., Sanchez, R. and Heene, A. (Eds), *Systems Perspectives on Resources, Capabilities, and Management Processes*, Pergamon, Amsterdam, pp. 19-39.
- Penrose, E.T. (1959), *The Theory of the Growth of the Firm*, Blackwell, Oxford.
- Peteraf, M.A. (1993), "The cornerstones of competitive advantage: a resource-based view", *Strategic Management Journal*, Vol. 14, pp. 179-91.
- Pidd, M. (1993), *Computer Simulation in Management Science*, 3rd ed., Wiley, Chichester.
- Porter, M.E. (1980), *Competitive Strategy*, The Free Press, New York, NY.
- Rumelt, R.P. (1991), "How much does industry matter?", *Strategic Management Journal*, Vol. 12, pp. 167-85.
- Sanchez, R. and Heene, A. (1997), "Reinventing strategic management: new theory and practice for competence-based competition", *European Management Journal*, Vol. 15 No. 3, pp. 303-17.
- Schroeder, R.G., Bates, K.A. and Junntila, M.A. (2002), "A resource-based view of manufacturing strategy and the relationship to manufacturing performance", *Strategic Management Journal*, Vol. 23, pp. 105-17.
- Selznick, P. (1957), *Leadership in Administration: A Sociological Interpretation*, Harper & Row, New York, NY.
- Senge, P.M. (1990), *The Fifth Discipline*, Doubleday Currency, New York, NY.
- Simon, H.A. (1979), "Rational decision making in business organizations", *American Economic Review*, Vol. 69 No. 4, pp. 493-513.
- Skinner, W. (1986), "The productivity paradox", *Harvard Business Review*, Vol. 64, pp. 55-9.
- Slack, N. and Lewis, M. (2003), *Operations Strategy*, Financial Times, Harlow.
- Slack, N., Chambers, S. and Johnston, R. (2001), *Operations Management*, 3rd ed., Financial Times, Harlow.
- Stalk, G. and Hout, T.M. (1990), *Competing Against Time – How Time-based Competition is Reshaping Global Markets*, The Free Press, New York, NY.
- Sterman, J.D. (2000), *Business Dynamics – Systems Thinking and Modeling for a Complex World*, Irwin/McGraw-Hill, Boston, MA.
- SubbaNarasimha, P.N. (2001), "Strategy in turbulent environments: the role of dynamic competence", *Managerial and Decision Economics*, Vol. 22, pp. 201-12.

-
- Swink, M. and Hegarty, W.H. (1998), "Core manufacturing capabilities and their links to product differentiation", *International Journal of Operations and Production Management*, Vol. 18 No. 4, pp. 374-96.
- Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18, pp. 509-33.
- Vennix, Jac A.M. (1994), *Group Model Building – Facilitating Team Learning Using System Dynamics*, Wiley, Chichester.
- Wack, P. (1985), "Scenarios: uncharted waters ahead", *Harvard Business Review*, Vol. 63 No. 5, pp. 72-89.
- Warren, K. (1999), "The dynamics of strategy", *Business Strategy Review*, Vol. 10 No. 3, pp. 1-16.
- Warren, K. (2002), *Competitive Strategy Dynamics*, Wiley, Chichester.
- Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5, pp. 171-80.

Corresponding author

Andreas Größler can be contacted at: agro@is.bwl.uni-mannheim.de

To purchase reprints of this article please e-mail: reprints@emeraldinsight.com
Or visit our web site for further details: www.emeraldinsight.com/reprints

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.