Competence and resource architectures

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Abstract *This paper aims to produce a justified, generic, pictorial architecture of the relationships between resources and competences within firms. It begins by providing definitions of the nature, scope and relationships between resources, capabilities and competences from the resource and competence literatures. In so doing, theory is refined and a linked resource and competence architecture is developed. The architecture distinguishes between high-level competences that customers recognize, for example fast product delivery, and competences that support high-level competences but are less visible customers, like competences in rapid knowledge acquisition and deployment. An empirical example is then used to illustrate how the architecture enables the construction of structured pictures of connected competences and co-ordinated resources within a manufacturing business. Finally, the architecture is critiqued and its value for managers in structuring competence performance improvement activities is discussed.*

Introduction

Competence and resource-based approaches to strategy making have received significant attention during the past decade (Hamel and Prahalad, 1994; Barney, 1991, 1996; Teece *et al.*, 1997; Eisenhardt and Martin, 2000) complementing rather than replacing Porter's (1980) industry-based approaches. Yet the ideas of competence and capability and the resources which underpin them are not new. Economics research from Penrose's (1959) theory of the growth of the firm, to evolutionary economic theory (Nelson and Winter, 1982) has also focused on the importance of a firm's tangible and intangible resources as the basis for sustainable, competitive advantage. Indeed it is increasingly believed, in both the economics and strategy literatures, that while a competitive advantage may be achieved by luck, a sustainable advantage requires a resource and competence-sensitive strategy process (Barney, 1986).

Progress on utilising these ideas has however, been lack-lustre (Williamson, 1999). One major problem may have been the abstract nature of the ideas. For example, while an organogram shows the formal, hierarchic view of a company's organisation and a balance sheet and profit and loss statement provide a financial view, what sort of representation could offer a resource/competence-based view? Porter's (1985) five forces and value chain

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ideas have been frequently represented pictorially but generic representations of resource and competence theory have been, as far as we know, absent from the literature. Developing such representations may be useful for researchers since the act challenges them to be explicit on the meaning of terms like resource, competence, capability and routine; their categorization; and the relationships between them. This is a particularly necessary task in this field since robust definitions of the concepts have not pervaded the literature with, as Nanda (1994) noted, almost every author submitting an individual set of definitions for competences, resources, and capabilities. Notwithstanding the efforts of Sanchez *et al.* (1996) to develop widely held definitions in the field.

Developing a representation inevitably began by considering extant definitions and frameworks for the key terms in the area. The objective was to extract features that enabled a generic, structural building block to be proposed and examined. The examination progressed in three stages: first the exploration of an extended resource/competence architecture; second its application using empirical data; and finally a discussion and critique on the architecture.

There are powerful reasons why such a critique should be rigorous. There are many pictures of the same set of competences and resources that could be drawn. Each picture, due to its size, shape, structure and the methods used to create it, will emphasize different aspects, reflect the perspective of the artist(s) and even be affected by the materials used. Berger noted that photographs, commonly presented as objective, factual records, were in fact interpretations:

> Photographs are not, as is often assumed, a mechanical record. Every time we look at a photograph we are aware, however slightly, of the photographer selecting that sight from an infinity of other possible sights. This is true even in the most casual family snapshot. The photographer's way of seeing is reflected in his choice of subject (Berger, 1972, p. 10).

Since visual representations of competences and resources will undoubtedly be biased, we have attempted to be explicit on distortions discovered in the representation proposed here, as well as outlining the potential benefits for managers and researchers and suggesting a tentative empirical research agenda.

Indeed the first distortion needs some discussion at this early stage. It concerns the use of the word "architecture" in this paper. "Architecture" traditionally implies two things, first solidity, bricks and mortar or carved stone, certainly it implies a lengthy construction time and longevity of the resulting structure. In a world where change is everywhere isn't there a better word? Perhaps "configuration" a word that might suggest something less solid would be more appropriate. The notion that it was possible to pull a competence and resource structure apart and re-configure it might be better. Yet it is the minority of organizations that need to continually re configure their operations on a rapid basis – examples would include those driven by rapid technological advance in the electronics and communication industries. Being speedy enough at adapting to such changes implies a resource architecture

honed with that in mind – organizations and systems that undergo consistent and persistent modification require systems that are embedded in the psyche of individuals and groups since it is impossible to update formal systems and procedures rapidly enough to keep up with these changes. In such rapidly changing circumstances co-ordination needs to be instinctive rather than prescribed. Many companies, not requiring such speed of change, will still experience a core competence becoming a core rigidity (Leonard-Barton, 1992) implying at least the potential for resources and competences to form solid architectures that are difficult to pull down.

The second implication is that "architecture" implies the presence of an architect and a design process. The idea that strong cultural preferences in businesses are shaped by their creators or those that have taken power over the long run is one with some resonance in the example case given later and in the experiences of, say, General Electric. However we do not intend to imply that business abounds with resource and competence architects indeed it is likely that these structures emerge as much by chance as by design – such a mechanism being essential for organizations to be different – one of the pillars of resource-based theory. Owners and managers of new organizations have significant ability to design their competence and resource structures however many aspects will be determined by their values and beliefs and are thus "designed" unconsciously. In established firms major re-design takes considerable time but even a three year manager can re-design parts of the architecture to improve operational performance. Improving strategic position, however, may well require that new competences need to be built at the expense of existing, traditionally valuable competences. In this situation the dynamic capability ideas of Teece *et al.* (1997) come to the fore and skilled architect(s) are required.

In this paper we limit our examples to operational improvement but would contend that the construction rules set out here can be applied generically and that to describe these rules as an architecture is at least defensible.

Definitions and frameworks

In this section the literature is reviewed and structured as follows:

(1) resources and routines;

(2) competences and capabilities; and

(3) integrating definitions.

Each section discusses definitions from leading researchers and provides, where appropriate, categorizations of these concepts.

Resources and routines

The inventor of the phrase "resource-based theory of the firm" defined resources as follows:

> By a resource is meant anything which could be thought of as a strength or weakness of a given firm. More formally, a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi-permanently to the firm. Examples of resources are: brand names, in house knowledge of technology, employment of skilled personnel, trade contacts, machinery, efficient procedures, capital etc. (Wernerfelt, 1984, p. 172).

Earlier Penrose described resources thus:

> The physical resources of a firm consist of tangible things – plant, equipment, land and natural resources, raw materials, semi-finished goods, waste products and by-products, and even unsold stocks of finished goods . . . There are also human resources available in a firm -unskilled and skilled labour, clerical, administrative, financial, legal, technical, and managerial staff (Penrose, 1959, p. 24).

But Penrose made a distinction between possessing a resource and using it.

> The services yielded by resources are a function of the way in which they are used – exactly the same resources when used for different purposes or in different ways and in combination with different types or amounts of other resources provide a different service or set of services . . . resources consist of a bundle of potential services and can, for the most part, be defined independently of their use, while services cannot be so defined, the very word "service" implying a function, an activity. As we shall see, it is largely in this distinction that we find the source of the uniqueness of each individual firm (Penrose, 1959, p. 25).

For Penrose, resources were, grammatically speaking, best expressed as nouns. They could lie dormant like idle plant or unused knowledge, alternatively, they could be used to provide a range of services. Grammatically speaking, services could therefore be best expressed as verbs.

Many categorizations of resources have been advanced, see examples in Table I. Each categorization can be relevant and useful in its own context and all overlap yet it is clear that Wernerfelt's wide latitude ('anything which could be thought of as a strength or weakness of a given firm') was to the point.

Nelson and Winter (1982), inventors of the term "routine", defined it in the context of an evolutionary theory of economic change:

> Our general term for all regular and predictable behavioral patterns of firms is "routine." We use this term to include characteristics of firms that range from well-specified technical routines for producing things, through procedures for hiring and firing, ordering new inventory, or stepping up production of items in high demand, to policies regarding investment, research and development (R&D), or advertising, and business strategies about product diversification or overseas investment. In our evolutionary theory, these routines play the role that genes play in biological evolutionary theory. They are a persistent feature of the organism and determine its possible behavior (though actual behavior is determined also by the environment); they are heritable in the sense that tomorrow's organisms generated from today's (for example, by building a new plant) have many of the same characteristics, and they are selectable in the sense that certain routines may do better than others, and, if so, their relative importance in the population (industry) is augmented over time (Nelson and Winter, 1982, p. 14).

They distinguished between three types of routine: "short run", determining the firm's operating characteristics; "investment" routines; and routines which

Resource category	Penrose (1959)	Hofer and Schendel (1978)	Coyne (1986)	Marino (1996)
Tangible	*			
Human	*	*		*
Physical		*		*
Organizational		*		*
Financial		*		
Reputational		*		
Regulatory			*	
Positional			*	
Functional			*	
Cultural			*	

Table I. Resource categorisations

modified over time various aspects of the operating routines. Routines were, therefore, comparable with Penrose's services – they were appropriately expressed as verbs.

Architecturally speaking, we could consider either the simplest routines or individual resources as our basic building blocks, each with its set of categories or types.

Competences and capabilities

Selznick (1957) was perhaps the first author to use the word "competence" in a strategic context. He defined "distinctive" competence as:

> ... commitments to ways of acting and responding built into the organization. When integrated, these commitments define the "character" of the organization (Selznick, 1957).

Both Peters (1984) and Porter (1979) have used the term "distinctive competence" to describe an ability that sets an organisation apart from its competitors, provides tangible benefits for customers and thus competitive advantage for the business. Following relative neglect the notion re-appeared as anecdotal data said to describe how major companies had used competence and capability ideas to achieve significant success. Prahalad and Hamel (1990), and Stalk *et al.* (1992) began this renewal of interest and with it emerged new phrases and definitions. Prahalad and Hamel (1990) defined "core competences" as:

> ... the collective learning in the organisation especially how to co-ordinate diverse production skills and integrate multiple streams of technologies (Prahalad and Hamel, 1990).

Their examples included Canon, where "core competences" in precision mechanics, fine optics and microelectronics were (said to be) used to enter new markets. Stalk *et al.* (1992) also pursued this theme, but distinguished between "capabilities" and Prahalad and Hamel's "core competences". In their view "capabilities" were superior business processes like supplier management, or new product introduction, rather than principally related to product technologies. Their examples were taken from the logistics and handling

processes of Wal Mart, as well as manufacturers like Honda, who were said to have superior dealer management capabilities.

The literature on competence encompasses many levels of analysis. At the corporate level lie the "core competence" ideas of Prahalad and Hamel (1990), where the main question is how these competences can be used to generate or enter new businesses. At the business-unit level lie Selznick's (1957) distinctive competences (valued by customers) and Liedtka's (1999) meta-competences (less obvious to competitors or customers but key to supporting distinctive and core competences). At this level the interest is in increasing the value, sustainability and exploitation of the business unit's competences. Moving deeper into the organization two more levels emerge – group and individual competence. Both are implicit in co-ordinating organizations (Malone and Crowston, 1994; Pentland *et al.*, 1999). The development of competent professionals for real world environments (Eraut, 1994) also lies at this level.

Finally operating at either corporate or business-unit level, Teece *et al.*'s (1997) dynamic capability ideas address how the need for new competences may be recognized and how resources may be re-ordered into new competences, more applicable to present or future contexts.

The term "capability", sometimes used interchangeably with competence, has given birth to further definitions, for example Winter defines an organizational capability as:

> ... a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organisation's management a set of decision options for producing significant outputs of a particular type (Winter, 2000, p. 983).

There are many more definitions in the literature depending on the perspective of the author and the unit of analysis of the study. But, since our aim is to develop an architecture from these notions, let us begin to extract some architectural detail.

While competences can be thought of as existing at many levels in an organization's hierarchy they can also be thought of as being connected and supporting particular higher-level competences. For example, the value of Canon's core competence at managing "diverse production technologies ..." (Prahalad and Hamel, 1990) will depend on the performance of competences involved in producing those technologies. Perhaps Prahalad and Hamel would include such competences within their definition of core competence but this is by no means clear from their articles and books. We shall propose an architecture reflecting the collection of individual services, routines, and competences into higher and higher-level competences that, at the highest level, are recognised by customers as offering particular levels of performance on competitive factors that interest them.

Integrating definitions

Many researchers during the 1990s began to define competences (and capabilities) in resource (and routine) terms. We shall take two examples. The first is from Grant (1991) who returned to Penrose's distinction between resources and services:

> There is no pre-determined relationship between the resources of a firm and its capabilities. The types, the amounts, and the qualities of the resources available to a firm have an important bearing on what the firm can do since they place constraints upon the range of organisational routines that can be performed and the standard to which they are performed. . . . a key ingredient in the relationship between resources and capabilities is the ability of an organisation to achieve co-operation and co-ordination between teams. (Grant, 1991, p.122).

Grant also asserted that an organization's style, values, traditions and leadership were critical enablers of good co-ordination and that these aspects could be viewed as intangible resources and common ingredients of a wide range of organizational routines. Co-ordination was therefore a key aspect of resource and competence architectures, indeed emerging here were Liedtka's (1999) ideas of meta competences – competences that affected a firm's ability to co-ordinate.

The second example is from Teece *et al.* (1997):

> Resources are firm-specific[1] assets which are difficult if not impossible to imitate. Patents, trademarks and certain specialized production facilities and experienced engineers are examples. Such assets are difficult to transfer among firms because of transaction costs and because the assets may contain tacit knowledge. When firm-specific assets are assembled in integrated clusters spanning individuals and groups so that they enable distinctive activities to be performed, these activities constitute organizational competences. Examples include quality, miniaturization and systems integration. Such competences are typically viable across multiple product lines. They rest on organizational routine.

Certainly any resource/competence architecture must reflect the importance of co-ordination.

Developing an architecture

Williamson (1999) has already suggested that Nelson and Winter's "routines" could form a basis for an architecture. Our preference, however, is for Penrose's (1959) dual notion of resource and service. This is for two reasons, first resources can be identified more easily and can generally be defined independently of their use (Penrose, 1959). And second, the dual notion appears more comprehensive – multiple services can be extracted from a resource dependent on the skills or otherwise of the co-ordination applied. The co-ordination applied may be implicit in the resource itself, especially of human resources, or applied through other resources like sets of rules, procedures, or a performance measurement and reward system.

A generic building block

Figure 1 illustrates the proposed generic building block. The triangle represents the boundary of the activity, enclosing the resource(s) on which it relies. The arrows on the boundary indicate the co-ordination being applied. The triangular shape is convenient for representing hierarchic structures, and has no other significance. The performance and specific nature of the competence, service, or routine (for the building block can represent all these terms) both depend upon its co-ordination. Note that resources are always expressed as nouns and competences, services and routines as verbs. The following equations express the recursive interaction between resources and competences:

$$\text{Resource(s)} + \text{Co-ordination} = \text{Service(s)},$$

$$\text{Services} + \text{Co-ordination} = \text{Competence(s)},$$

$$\text{Competences} + \text{Co-ordination} = \text{Higher-level competences}.$$

Co-ordination is never independent of the resources involved – managers and workers co-ordinate themselves as individuals and in work groups – all are resources in one sense and co-ordinators in another (Mahoney, 1995). Ideally, both senses should be visible in a comprehensive competence representation.

Extending the architecture

How might these building blocks be linked? Figure 2 shows an observable, "customer perceived competence", supported by two sub-competences. The first, on the left, we have called a "resource development competence". Such competences act on resources to change their state. The detailed representation is important – the apex of a resource development competence pierces the boundary of the higher-level competence and resides vertically below the centre of the resource concerned, see resource B in Figure 2.

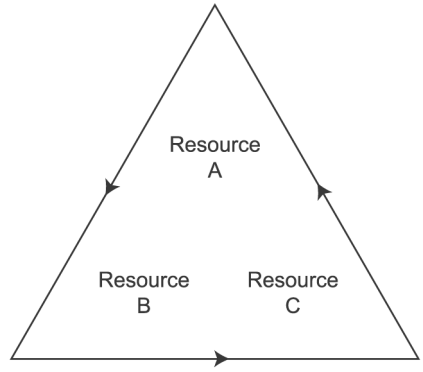

Figure 1.
The service, routine or competence building block

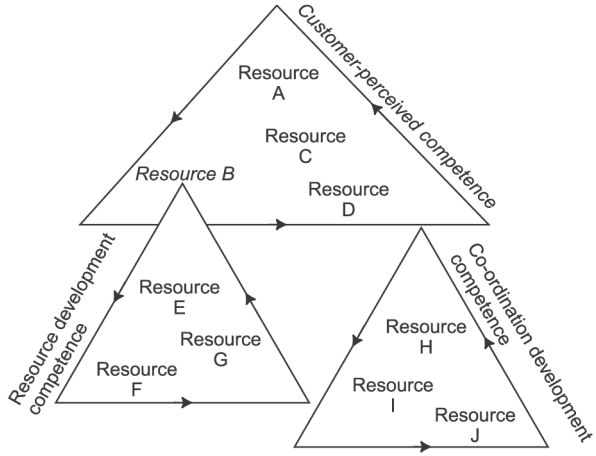

Figure 2.
Competence architecture

The second, on the right, is called a "co-ordination development competence". These competences affect the co-ordination of higher-level competences. Again the detailed representation is important – its apex touches the boundary of the higher-level competence affected to provide a pictorial link with the arrows that indicate the co-ordination being applied. Each block can therefore be linked either to resources within a higher competence or to the arrowed boundaries representing the co-ordination of higher-level competences.

Our assertion is that these are the only two ways this resource/competence architecture can be constructed. Since the building block is defined as a set of resources and a co-ordination force, there is no other way to logically assemble them. In practice firms will have many observable competences at work and this can be represented quite simply, as in Figure 3. A firm's competence architecture can, therefore, become very involved especially, when competences use common resources. In such cases, since many resources are

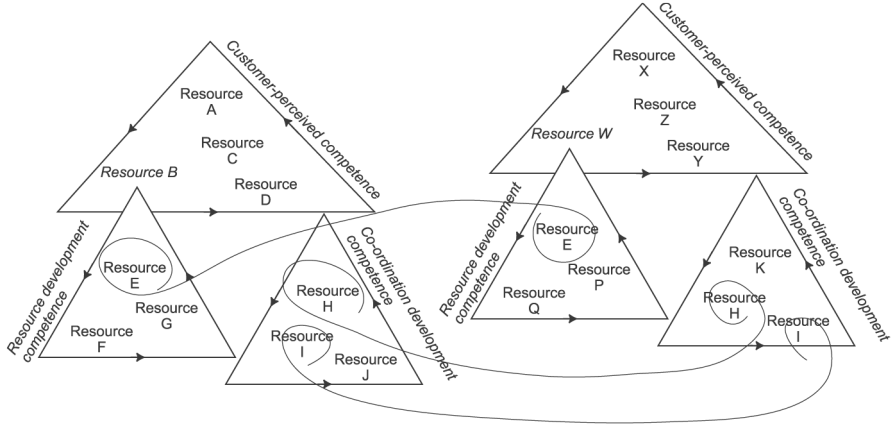

Figure 3.
Multiple competences, note shared resources

neither divisible nor replicable, their services must be shared between competences.

An application of the architecture

The application is based on data from a strategy development case conducted during 1993 and 1994, selected because of the firm's outstanding quality performance in a quality sensitive market. The resource identification was carried out from strategy charts (Mills *et al.*, 1998) and contemporaneous interview data, with the aim of developing and testing alternative representations of competence architectures.

SDQ remains a supplier to car and truck original equipment manufacturers (OEMs). Its reputation for delivered product quality was very good; in the three years prior to the strategy study only one batch had been returned by a customer on quality grounds. Figure 4 shows the resources that appeared to underpin its performance at delivering quality product, structured according to the proposed architecture.

First, the resources SDQ tended to emphasize to its customers:

- A set of beliefs at top-management level that delivered quality was a key differentiator in the market.

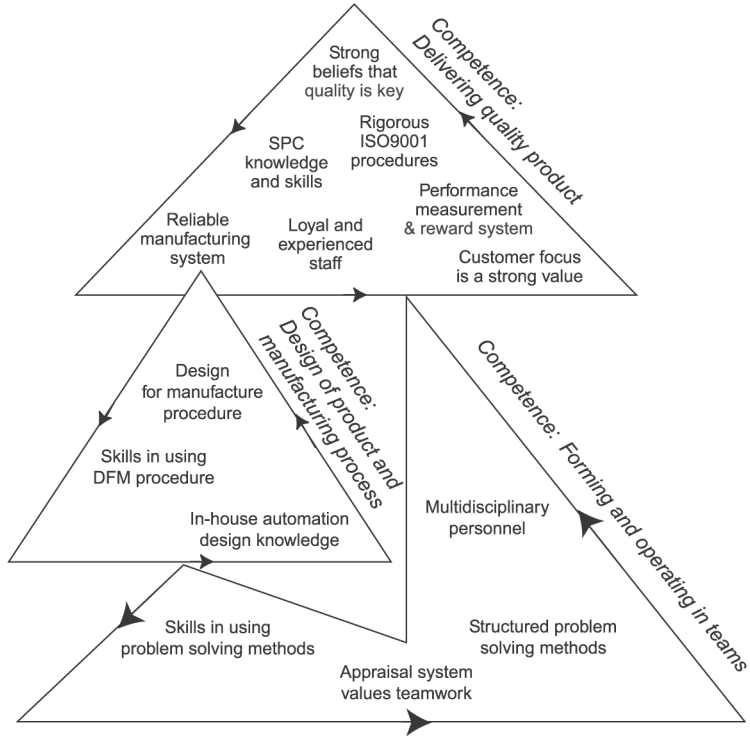

Figure 4.
SDQ competence: delivering quality product

- A performance measurement and reward system that valued delivered quality highly.
- Statistical process control knowledge and expertise built over several years with regular training for new recruits.
- Rigorous ISO 9001-based quality systems, with effective concentration on correcting root causes.
- An increasing customer focus value within the workforce, built over several years and driven by extensive training, visits to customers' production lines, and ongoing contact with peers on customer production lines. (Operators knew why it was important to pack products in a particular way because they had seen or been shown how they were loaded onto the customer's production line).
- A reliable manufacturing system.
- Neglecting those leaving within six months of joining, the average length of service is approximately 12 years hence another resource was experienced staff.

Another resource customers would have noticed was a managing director who, at the time of the strategy study, had been in this role for over nine years.

But these resources did not account for all of their performance. Their product and manufacturing process design competence also performed at a level necessary to maintain the manufacturing system's reliability through numerous new product introductions and automation projects aimed at cost reduction and consistent quality:

- a design for manufacture (DFM) procedure optimised for their products;
- skills and experience built from practicing the DFM procedure (seven or eight products yearly);
- a large production engineering group with automation design knowledge and skills.

A further high performing competence in "building and working productively in teams" assisted the co-ordination of the other competences. Its underlying resources appeared to be:

- An appraisal system that valued an individual's ability to work in teams.
- Structured techniques for problem solving acquired through regular training.
- Problem-solving skills developed through application of these techniques.
- Multi-disciplinary personnel. (This depended on a system of job transfer and rotation that meant most engineers and managers had worked in three functions from quality, line management, manufacturing engineering and logistics.) They could understand one another's perspectives.

Discussion

Our discussion is divided into three areas: first, the application; second, the strengths and weaknesses in the proposed architecture and, finally, its potential utility for managers.

The application

The application demonstrated the feasibility of the architecture, it did not set out to comprehensively represent SDQ's delivered quality competence. Our preliminary reflections on this are as follows:

- SDQ's product delivery competence could be represented by one triangle containing all the resources in Figure 4. However, the structural detail enabled by the architecture conveys more explanatory power than that. In this sense the architecture can work well in being able to picture resource and competence structures.
- The application showed how resource and co-ordination development competences could be applied.
- The application showed how "co-ordination development competences" could affect more than one competence. Indeed the competence in "forming and operating in teams" could be expected to support the co-ordination of many other competences in SDQ.

Critique and potential improvements

The application highlights three main issues with the architecture, the first concerns the need for a narrative as well as a representation, the second concerns the decomposition of aggregate resources, and third the representation of co-ordination in the architecture.

Narrative support. Perhaps unsurprisingly the architecture suggested does not stand-alone, it needs the narrative explanation provided. The reason for this seems to be centred on the dynamics of resource creation, that is, the histories of individual and collective resource development. Our experience is that the writer is drawn into explaining something of why a resource is important, how it was developed and over what time period. The need to embody the learning necessary to develop resources and co-ordinate them into competences, emphasized by Mahoney (1995), is tangible. See, for instance, the resources – "Multidisciplinary personnel" and "DFM skills and knowledge", shown in Figure 4 and described in the narrative. There is thus a frequent choice between extending the narrative or extending (complicating?) resource descriptions. The balance will be a judgment constrained by the intended size of the picture.

Essentially, however, a narrative history of how resources emerged is a necessary part of a comprehensive description of a resource/competence architecture.

The application also generated the related issue of qualified resource descriptions, for example a reliable manufacturing system. Adjectives for resources and adverbs for competences must be permitted since resource-based theory asserts that many resources in real firms will be firm-specific and this specificity needs to be represented. This may emerge as a qualified resource or competence description or as part of the narrative. Competences may also offer both slightly different services to customers and perform at different levels compared with competitors. Critically the source of such qualifications needs to be specified – is this simply local managerial opinion or is it based on particular research or customer feedback?

Resource decomposition. The architecture enables competences and resources at any firm level to be decomposed into as detailed or focused a picture as required. For example, a production line into the machines that populate it, the systems that control it, and the sub-competences that maintain it, feed it with raw materials, modify it and so on. The decomposition of the "reliable manufacturing system" resource in Figure 4 is an example. Here the focus is on what supports the reliability of the production system. However, production systems can display other qualities. For example many of the manufacturing systems in SDQ have automated transfers between machines – this helped create a low cost manufacturing system and also raised the question – how should multiple qualities be represented in the architecture? Figure 5 illustrates three options.

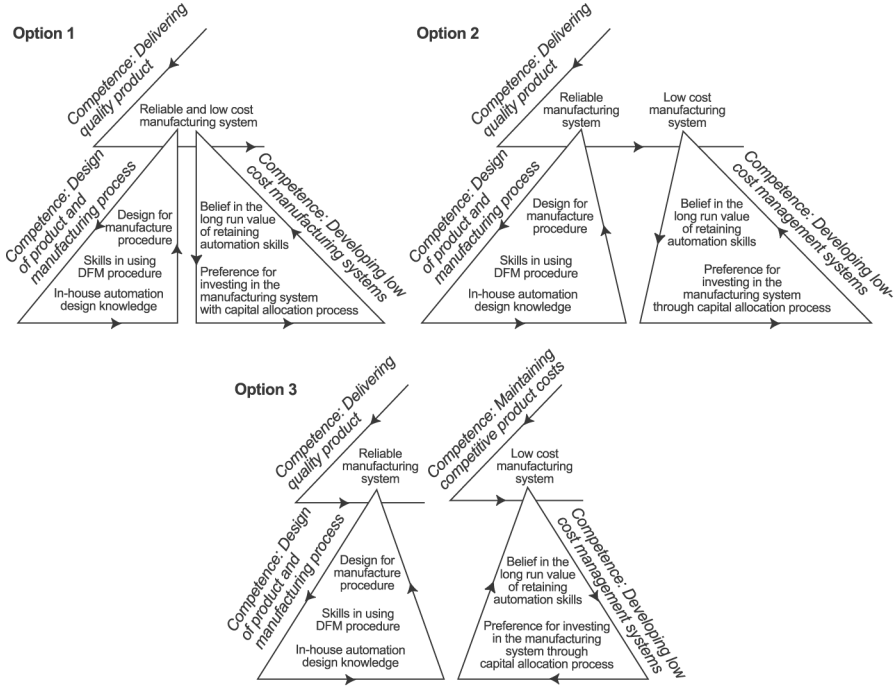

Figure 5.
Options for decomposing aggregated resources with multiple qualifications

In the first the "reliable manufacturing system" resource was re-qualified as a "reliable and low cost manufacturing system" with one resource building competence feeding it and containing extra resources related to the cost of the operation of the manufacturing system and/or its reliability. In this case a "belief in the long run value of retaining automation skills" and a "preference for investment into the manufacturing system" were relevant. This resource development competence was renamed to include its role in cost reduction.

In the second a separate resource "low cost manufacturing system" was added and fed by a new resource development competence, "Design of a low cost manufacturing process" complete with relevant resources.

Unfortunately both of these options are unsatisfactory because the high-level "delivering quality product" competence does not rely directly on a low cost production process. No doubt costs are always of high priority in any commercial environment and particularly so in most manufacturing environments. High reliability production processes produce not only high conformance quality but also low scrap costs – they do not necessarily produce competitive product costs – another major competence that customers should recognize. Many other resources are involved in that endeavour than simply the manufacturing system.

The third route is to identify a separate resource called "low cost manufacturing system" that could be placed in another, parallel customer perceived competence, perhaps called "providing competitively priced products". We have a preference for this approach for two reasons: first, highly aggregated resources (like the manufacturing system) are often involved in several competences in different business dimensions. A clearer picture results from showing the resources underpinning particular performance in say quality conformance, product cost, delivery reliability etc. results from this approach. Second the architecture may be made more comprehensive by early decomposition of the overall competence architecture since it creates a clearer focus for the identification of resource building competences. This approach can also lead to some resources being represented more than once in an architecture and while this does not necessarily mean these resources are very important it does mean that they have wide influence through providing a range of services.

One rule to express this could be to begin any organization's resource architecture with the customer perceived competences positioned at the top of its competence hierarchy. In a comprehensive picture, however, we would also include Teece *et al.*'s (1997) "dynamic capability". Positioned, perhaps, at the very apex of an organization's competence architecture with the role of examining whether circumstances were changing, oft-sated assumptions were losing relevance and having the potential to re-configure the firm's resource architecture toward new circumstances and opportunities.

Co-ordination issues. The architecture does little to explain the detailed co-ordination present in a competence. In the SDQ example a set of co-ordination resources are present – the performance measurement system and appraisal systems, multi-disciplinary personnel, various beliefs and values, especially those of the Managing Director. Given this was a high performance competence, a number of coherent co-ordination related resources focused on outgoing quality might have been expected to be present. Such resources might benefit from being highlighted and examined for the influence they have. For example, many firms have performance measurement systems that contain similar quality data to SDQ. Yet using Penrose's distinction between resources and services, it is unlikely that these firms extract as influential a service from their quality data as SDQ. These organizations will co-ordinate differently and this, as well as differences in detailed resources, will lead to different expectations and actual levels of outgoing quality. An additional rule should be to highlight resources that have potential co-ordinating influences.

In examining this example of superior quality conformance performance, attention should be drawn to the role of the Managing Director in ensuring coherence about the systems, procedures and beliefs he had been able to influence and develop over his longish tenure. Having studied other business units in this corporation it seems to us that this particular managing director was also able to resist or place in context many of the initiatives raised the corporate organization that were of doubtful benefit to his business.

Preliminary conclusions

We have criticized the architectural rules on two main counts. First, they do not sufficiently emphasize the importance of co-ordination in company resource/competence structures. To ameliorate this we have suggested highlighting resources that provide a co-ordination role, for example formal and informal procedures and systems. Second, the architecture does not stand-alone – a narrative is needed to explain aspects of the representation and the balance between pictorial and narrative is uncertain. However we believe any architecture for resources and competences would suffer this criticism. On the other hand, the architecture survived an application[2] providing the preliminary conclusion that these architectural definitions provide structures with more explanatory power than a simple collection of the relevant resources.

Assembling an actual architecture does, however, seem to draw the attention of the analyst to how current competences are being co-ordinated; into questioning how the co-ordination of the past development of a competence was achieved (note the managing director's apparent role) as well focusing on deeper structures that allow high-level, market-sensitive performance to be maintained, improved or degraded. These seem to be important aspects of taking a resource-based perspective.

In practice, however, how useful is this kind of analysis to managers? Another preliminary conclusion, based on three cases (Mills *et al.*, 2003) is that managers with the capacity to reflect appear to show serious interest in the structures produced and the assistance they provide in making a resource-based view more tangible and in designing improvement actions using this view. Since, given this definition of architecture, the performance of any competence at any hierarchic level depends on the following six factors:

(1) the health of its resources (e.g. a machine's state of repair, or a human's motivation);

(2) the appropriateness of its resources to the services required (e.g. how a human's skill, experience and training matches the particular service required);

(3) the co-ordination of the resources (which result in much of the details of the competence outputs and much of the performance of those outputs);

(4) the performance of sub competences which act to develop co-ordination aspects or resource health and/or appropriateness;

(5) the priority given to the activity, particularly where shared resources are involved; and

(6) how often the competence is exercised (practice helps).

By inspecting these architectures managers can make assessments based on these factors – how can particular resources be come more appropriate to their tasks? How can resources be better co-ordinated? The evidence (Mills *et al.*, 2003) is that this approach tends to stimulate new ideas for improving competence performance which arise from the different perspective resource-based approaches provide.

Summarizing, by following Penrose (1959), we produced an architecture that emphasized resources. However, since resources can be defined relatively independently of their use (or services) they are easier to observe and perhaps easier to visualize in alternative configurations and under different co-ordination regimes. Perhaps the resource emphasis can also motivate managers to concentrate more on co-ordinating their resources into services and competences better aligned to their strategies than on calling for new resources. If so, perhaps earlier criticisms are not so damaging – at least for managers.

For researchers the architecture offers a means of documenting resource-based structures and may draw researchers into the empirical work so lacking in resource-based research. Two research themes might be to investigate similar competences within an industry and across industries to contrast the roles of resource investment, co-ordination-related resources and the detailed co-ordination (or management) practices that are associated with superior performance.

Notes

1. This definition of resources needing to be firm-specific seems unduly restrictive. Tradable factors of production are still resources within our definition and those of other researchers (see Table I). For example, a firm with capital has a resource that can produce a range of new services.
2. Two other applications support these conclusions.

References

Barney, J.B. (1986), "Strategic factor markets: expectations, luck and business strategy", *Management Science*, October, pp. 1231-41.

Barney, J.B. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120.

Barney, J.B. (1996), *Gaining and Sustaining Competitive Advantage*, Addison-Wesley, Reading, MA.

Berger, J. (1972), *Ways of Seeing*, Penguin, Harmondsworth.

Coyne, K.P. (1986), "Sustainable competitive advantage – what it is and what it isn't", *Business Horizons*, January/February, pp. 54-61.

Eisenhardt, K.M. and Martin, K.A. (2000), "Dynamic capabilities: what are they?", *Strategic Management Journal*, Vol. 21, pp. 1105-21.

Eraut, M. (1994), *Developing Professional Knowledge and Competence*, Falmer Press, London.

Grant, R.M. (1991), "The resource-based theory of competitive advantage: implications for strategy formulation", *California Management Review*, Spring, pp. 114-35.

Hamel, G. and Prahalad, C.K. (1994), *Competing for the Future*, Harvard Business School Press, Boston, MA.

Hofer, C.W. and Schendel, D. (1978), *Strategy Formulation: Analytical Concepts*, West Publishing, St Paul, MN.

Leonard-Barton, D. (1992), "Core capabilities and core rigidtities: a paradox in managing new product development", *Strategic Management Journal*, Vol. 13, pp. 111-25.

Liedtka, J. (1999), "Linking competitive advantage with communities of practice", *Journal of Management Inquiry*, Vol. 8 No. 1, pp. 5-16.

Mahoney, J.T. (1995), "The management of resources and the resource of managers", *Journal of Business Research*, Vol. 33, pp. 91-101.

Malone, T.W. and Crowston, K. (1994), "The interdisciplinary study of co-ordination", *ACM Computing Surveys*, Vol. 26 No. 1, pp. 87-119.

Marino, K.E. (1996), "Developing consensus on firm competences and capabilities", *Academy of Management Executive*, Vol. 10 No. 3, pp. 40-51.

Mills, J.F., Platts, K.W. and Bourne, M.C.S. (2003), "Applying resource-based theory: methods, outcomes and utility for managers", *International Journal of Operations & Production Management*, Vol. 23 No. 3.

Mills, J.F., Neely, A.D., Platts, K.W. and Gregory, M.J. (1998), "Manufacturing strategy: a pictorial representation", *International Journal of Operations & Production Management*, Vol. 18 No. 11, pp. 1067-85.

Nanda, A. (1994), "Resources, capabilities and competencies", working paper, Harvard Business School, Boston, MA.

Nelson, R.R. and Winter, S.G. (1982), *An Evolutionary Theory of Economic Change*, Harvard University Press, Boston, MA.

Penrose, E.T. (1959), *The Theory of the Growth of the Firm*, Basil Blackwell, Oxford.

Pentland, B.T., Osborn, C.S., Wyner, G. and Luconi, F. (1999), "Useful descriptions of organisational processes: collecting data for the process handbook", working paper, Center for Co-ordination Science, MIT/Sloan, Cambridge, MA, pp. 1-12.

Peters, T.J. (1984), "Strategy follows structure: developing distinctive skills", *California Management Review*, Spring, pp. 378-89.

Porter, M.E. (1979), "How competitive forces shape strategy", *Harvard Business Review*, March/April, pp. 66-75.

Porter, M.E. (1980), *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, New York, NY.

Porter, M.E. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York.

Prahalad, C.K. and Hamel, G. (1990), "The core competence of the corporation", *Harvard Business Review*, May/June, pp. 79-91.

Sanchez, R., Heene, A. and Thomas, H. (1996), "Towards the theory of competence-based competition", in Sanchez, R., Heene, A. and Thomas, H. (Eds), *Dynamics of Competence-based Competition: Theory and Practice in the New Strategic Management*, Elsevier, Oxford.

Selznick, P. (1957), *Leadership in Administration: A Sociological Interpretation*, Harper & Row, New York, NY.

Stalk, G., Evans, P. and Shulman, L. (1992), "Competing on capabilities: the new rules of corporate strategy", *Harvard Business Review*, March/April, pp. 57-69.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-33.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, No. 5, pp. 171-80.

Williamson, O.E. (1999), "Strategy research: governance and competence perspectives", *Strategic Management Journal*, Vol. 20, pp. 1087-108.

Winter, S.G. (2000), "The satisficing principle in capability learning", *Strategic Management Journal*, Vol. 21, pp. 981-96.