
Manufacturing strategy: a pictorial representation

Manufacturing
strategy

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Introduction

A chief executive officer's (CEO's) description of his/her manufacturing strategy, although honestly expressed, may be incomplete, inaccurate or both; the manufacturing director's overhead transparencies might put a gloss on the facts; and a researcher's observation of shopfloor practice may lack important current and historical context. Fully identifying and representing a firm's manufacturing strategy is not a trivial matter; difficult issues are met in the attempt. What definition of strategy is being used? Whose perception of strategy is being taken? And how might the validity and comprehensiveness of the description be assessed? Published manufacturing strategy development processes (Fine and Hax, 1985; Platts and Gregory, 1990) identify manufacturing strategy through discussions on past policies in strategic decision areas based on Hayes and Wheelwright's (1984) definitions. Current strategy is then represented as keywords or phrases. Researchers count the discussion itself as very important but its richness is unrecorded and retained only in the memories of the participants. In this form strategies may be difficult to communicate. Indeed, empirical studies (Swamidass, 1986) have shown that manufacturing strategies in most firms were neither visible nor obvious. More recently, in an article assessing the modest impact of manufacturing strategy theory on practice, Skinner (1996) contended that one of the major problems for managers implementing manufacturing strategy ideas was a proven inability of managers to step back and assess the coherence of their strategies. Perhaps keywords or phrases accompanied by memories from strategy meetings are at too high a level of aggregation and too easily re-interpreted to enable managers to assess the coherence of their strategies. We contend that richer methods of representing manufacturing strategies need to be developed to assist their communication and to help managers stand back.

This research investigates a fundamental question: how might an organization's manufacturing strategy be identified and documented by managers in a form that is more useful and communicable than published methods? By focusing on methods managers could use, our contribution is to practice rather than to theory. In so doing we attempt to generate knowledge and a generalisable technique based firmly in established theory. The

This paper was supported by EPSRC grants GR/H 21470 and GR/K 53086.

International Journal of Operations
& Production Management,
Vol. 18 No. 11, 1998, pp. 1067-1085,
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knowledge resulting from this research is not aimed at theory building, but rather at knowledge on dealing with strategic issues in the managerial world. It also begins to address Skinner's (1996) second concern that insufficient research on the process of strategy making has held back the adoption of manufacturing strategy ideas.

There are clues to alternative representations of strategy in previous research. To describe their manufacturing strategy (Fine and Hax, 1985), managers looked at their firm's history to identify past and current policies. The past is important and initial conditions matter:

Unless one understands how an organization got where it is, it is difficult to determine the appropriate steps to take next. If not properly understood, the forces that drive it in a certain direction will continue to operate, despite whatever well intentioned decisions are imposed upon it (Hayes *et al.*, 1988, p. 25).

A historical view might help managers to stand back; to assess the coherence of their strategies; and to understand the forces that formed them. If so, how might managers most effectively access the past? Researchers have used interviews with published and otherwise documented sources and then represented them in narratives, sometimes with diagrams to assist interpretation. Examples can be found in Mintzberg and Waters' (1982) account of Steinberg's strategy development from grocer to supermarket chain and Hickson *et al.*'s (1986) tracking of strategic decisions over time. However, these approaches demand considerable effort to acquire, structure and represent the data, effort that most managers are unlikely to make available.

Another approach is to use pictures. Meyer (1991) advocated visual approaches for collecting and representing the "fuzzy multi-dimensional constructs met when analysing organizations" and strategy is certainly one such construct. There are benefits to using a picture. Structured, pictorial approaches enable data gathering and representation to be combined; assist data analysis and therefore may enable a representation to be built and analysed in the time managers will make available. Patterns, sometimes associated with strategic data, can be more accessible from pictures than text. Pictures can be created and viewed by groups and may help develop a common understanding of a strategy. However, although pictorial approaches may be attractive, many pictures of the same strategy could be drawn. Each picture, due to its size, shape and the methods used to create it, will emphasize different strategic aspects, reflect the perspective of the artist(s) and even be affected by the materials used. Researchers studying questionnaire-based data, interview transcripts or relying on documented sources understand the biases of their methods. What are the biases in a particular picture of strategy?

We therefore begin by proposing a representation of manufacturing strategy, called a "strategy chart", which draws on established manufacturing and business strategy theory. Its structure is explained and a priori theoretical biases are described. Next, a method for constructing the chart is summarized and critiqued leading to the identification of further potential biases. The

approach is then tested in three applications and distortions discovered in practice are discussed. Finally, tentative conclusions on the limitations and utility of the approach are drawn and its potential role within a wider manufacturing strategy development process is discussed.

Strategy charts

This section is in three parts: first, the events that populate the chart are defined. Second, the axes are described, and finally the chart's theoretical biases are summarized. We describe the chart itself – not how to draw it – so our “theoretical” biases do not include those introduced by the elicitation method. These are covered later.

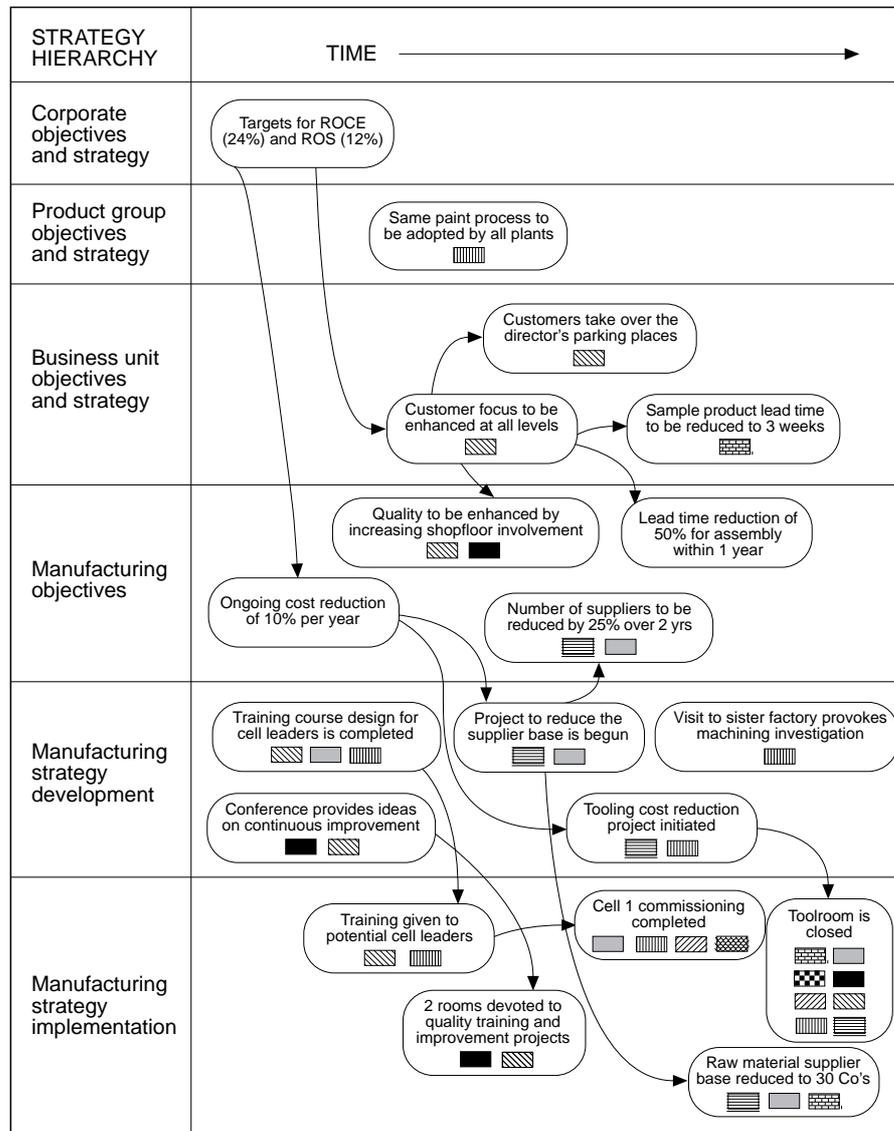
Refer to Figure 1, which shows a diagrammatic extract from a manufacturing strategy chart of a business unit reporting to a corporate holding company via a worldwide product group.

Strategic events

To reach business and corporate goals, supportive cost, time, quality and flexibility goals must be developed for manufacturing (Skinner, 1969). These manufacturing goals are achieved and sustained by a “pattern of decisions” (Hayes and Wheelwright, 1984). Note that Hayes and Wheelwright (1984) appear to have based their “pattern of decisions” on Mintzberg's early work, but later, Mintzberg and Waters (1985, p. 257) amended their view of strategy to “... patterns in streams of actions, not decisions ...”. We follow their later view in this article. These actions are taken in a set of strategic areas which encompass manufacturing strategy and around which there has been significant agreement (Anderson *et al.*, 1989). Hayes *et al.*'s (1988) strategic decision area framework is typical, consisting of: capacity, facilities, process technology and vertical integration, quality policy, production planning, human resources, new product introduction, organization and performance measurement and reward.

Actions in different decision areas are known to interact, however, Adam and Swamidass (1989) observed a large gap in the literature on the nature of these interactions.

The chart contains verifiable objectives, decisions and actions, called events, most of which relate to Hayes *et al.*'s (1988) manufacturing's strategic decision areas. Event descriptions should be factual, include a date to the nearest quarter and be colour coded according to the manufacturing strategic decision area(s) covered. Multi-coloured events indicate potential interactions or linkages between decision areas though it is not always possible to associate some events, particularly manufacturing or business objectives, with manufacturing decision areas. For example, it may not be predictable which strategy decision areas will be involved in an event announcing an “Ongoing cost reduction of 10 per cent per year” (see Figure 1) – there will be choices in how that may be achieved. Some events may not even relate to the decision areas, for instance a change in company ownership or the gain of a particular order. However, both might lead to significant strategic changes within manufacturing. Finally,



Key

- New Product Introduction
- Organization
- Human resources
- Performance measurement
- Production control
- Capacity
- Quality
- Vertical integration/suppliers
- Process technology
- Facilities

Figure 1.
Diagrammatic example
of a strategy chart

events may also be connected – if any events are thought to lead to other events they can be joined by arrows. These definitions theoretically enable the chart to:

- contain business and manufacturing objectives;
- contain actions and decisions in manufacturing's strategic decision areas;
- indicate interactions or linkages between decision areas;
- show perceived causal connections between events;
- contain any event perceived to be of strategic importance.

Chart axes

Time was chosen for the horizontal axis to enable past and planned events to be included and to enable the chart to be updated easily. For the vertical axis a top-down strategy hierarchy was preferred because it was the most traditional precedence of strategic levels in practice and in the strategy literature (e.g. Hofer and Schendel, 1978). Including “higher” strategy levels enables connections between manufacturing events and these levels to be shown. Chart hierarchies above the manufacturing objectives level depend on organization structure and are configured to each application.

The decision to distinguish between strategy development and implementation (see Figure 1) arose from the need to separate strategy development events, typically investigative projects and the like, from “realised” and “intended” (Mintzberg and Waters, 1985) implementation events where actual changes were made to the manufacturing system. This choice of axes theoretically enables the chart to:

- contain “realised” (or implemented) actions and “intended” (or planned) actions and thus enable the identification of current strategy;
- be easily updated over time;
- show connections between manufacturing, business and other strategy levels.

A priori bias

Pettigrew's (1992) framework for business strategy has been used to help identify biases in the proposed chart. This framework is composed of process, or how strategy is made; content, the constituents of a strategy; and context, which includes both external factors such as economic/business, political, and social environments and internal factors covering the enterprise's resources and capabilities plus its cultural and political facets.

Four areas of weakness were anticipated. First, since events are defined as factual and without opinion the chart cannot capture the rich, political context of the strategy process. Second, neither the axes chosen nor the event definitions prompt consideration of other functional strategies or external technology and manufacturing practice development relevant to a

manufacturing strategy. These aspects of internal and external context are likely to be incomplete. There is one exception, events in the manufacturing strategy decision area, “new product introduction”, are likely to strongly overlap with development and marketing strategy. Thus the main source of external context is likely to emerge through the objectives negotiated with business and corporate strategy levels and from events as diverse as technological advances, mergers, or the loss of an apparently crucial order. Third, the chart’s ability to help identify interactions or linkages between decision areas may be limited, and finally, manufacturing resources and capabilities will not be shown.

These limitations result from compromises made to emphasize manufacturing strategy content and to limit the chart’s complexity to a level that would not deter managers. However, in the next section, further limitations are to be found in constructing charts of this kind.

Data collection method

Four data collection issues implicit in a strategy chart will be discussed. First, what is the difference between strategic and non-strategic events and who decides? Second, how are the data produced validated? Third, how comprehensive are the data produced? And fourth, since the task requires managers to be trained in the procedure and may also require facilitation – what is the facilitator’s impact on the outcome?

Strategic events – in whose opinion?

One of the key choices in developing the method was between individually constructed charts and a chart developed by, and representing, the shared perceptions of a group (Huff and Fletcher, 1990). Our choice was for the latter – a group involved in manufacturing strategy development and implementation – and so the choice of strategic versus non-strategic was therefore theirs. There were four reasons for this: first, since the methodology was intended for managers the chart needed to be built speedily; second, since the chart was intended to help communicate current strategy a joint approach that might build consensus was preferred. Third, discussion in a group environment might help individuals to recall past actions. And finally, the use of a number of actors to construct the chart was one way of reducing errors in the chart, see below. Despite this there remained risks of “group think” (Janis, 1979) and therefore missing potentially differing interpretations of past and current events. These matters are important but are mainly concerned with why and how action was taken – the process rather than what was implemented – the content. The intention of the chart described here is to represent strategy content over time.

Validity

The unchallenged recollection of at least two charters was regarded as sufficient evidence to include it on the chart. This degree of validation was chosen with managers in mind since it was believed that, even were it specified,

the collection of potentially large quantities of documentary evidence would not be carried out. Given this restriction, are the kinds of data sought particularly sensitive to error or bias?

Researchers on retrospective accounts of strategy have identified many reasons why informants give biased or inaccurate data. For example, they may invent facts or stories in order to appear important; they may be motivated to bias their account since to be frank might have adverse career implications or they may simply have imperfect memories (Huber and Power, 1985). Golden (1992) showed that almost 60 per cent of primary care hospital CEOs erroneously recalled their own characterisation of their strategy of two years earlier. However, he noted that the subjectivity inherent in characterising strategy meant that the unreliability of CEO recall could not be extrapolated to all subject areas or to all managers. In particular, factual descriptions (required by strategic events) were likely to be more accurate than accounts of past beliefs or intentions (Golden, 1992). Thus the nature of the event descriptions in this methodology make them likely to be more reliable than more subjective matters. However, given that causal connections between past events can be interpreted as past intentions then these connections are likely to be less trustworthy than event descriptions. As Schwenk (1985) observed, managers may simplify and add logic to their recollections.

Comprehensiveness

Chart comprehensiveness may be viewed from two perspectives. First, the events can be checked against Hayes *et al.*'s (1988) content framework and any lack of events on say, "organization" or "facilities" can prompt further elicitation in those areas. Hence the comprehensiveness of the chart's decision area scope may be checked. Second, has all or even the majority of strategic events been elicited? Are there areas that need specific attention? Observations from the research test cases threw light on these questions and they are discussed later.

The facilitator

The facilitator intervenes in two ways. First, to teach the basis of the chart and its construction – where events fit on the chart and why? This promotes a view of manufacturing strategy as patterns of actions, of objectives and of relationships with business and "higher" strategy levels. Second, to assist in the early stages of populating the chart where facilitation inputs are confined to repeating event descriptions to help ensure their clarity across the group and probes to elicit information. The probes used are no more nor less than those commonly used in face to face interviews, for example: what happened next? What led up to that? Was there anything else? The facilitator encourages one group member to take over this role as soon as practicable and then gives facilitation advice, as necessary.

In many respects this method of accessing historical and planned strategic events is much like a structured interview with the structure explained in advance. Unlike most interviews, however, the resulting data are displayed for all to see on coloured Post-its (registered trademark of 3M) placed on the chart.

Testing the method

The objective of this research is to test the utility, validity and comprehensiveness of a pictorial approach to the identification and communication of manufacturing strategy content. It is not our intention to describe the detailed findings from each case, rather we use examples from the cases to check the theoretical, predicted biases and draw out unpredicted biases found in practice. Thus, following a description of the research methods used, the cases are introduced and observations are grouped and discussed under six headings: strategy content identification, strategy process, strategy communication, validity, comprehensiveness and potential improvements.

Strategy process research demands access to senior managers and the high external validity delivered by working on live problems. As Chakravarthy and Doz (1992) point out:

It is true that the strategy process cannot be researched well without possibly affecting its very nature. Rather than ignore the issue or only harp upon the occasional consulting dimension to process research, we believe action research should gain more legitimacy in the strategy process subfield (p. 10).

Checkland *et al.* (1983) and Schroeder *et al.* (1990) have also supported the validity and applicability of action research in manufacturing. As Susman and Evered (1978) state:

Action research constitutes a science with a different epistemology ... As a procedure for generating knowledge, we believe it has far greater potential than positivist science for understanding and managing the affairs of organizations.

An action research approach was inevitable for two principal reasons. First, it was essential to conduct the research within a real strategy-making context so that managers and researchers could reflect and comment on the utility of the approach within that live context. Second, the firms (see Table I) were interested in a payback – action or learning for the commitment of senior managers' time. Their explicit purposes for collaboration were diverse. The corporate manufacturing director in case 1 desired an evaluation of his manufacturing strategy development process (Platts *et al.*, 1994), here a different view of current strategy content was a by-product. The business unit director in case 2 looked for a review of current manufacturing strategy; its alignment with business needs and a contribution to building a new team in a newly created, stand-alone business unit.

In case 3 the business unit director simply hoped to learn from the experience, viewing the collaboration as an experiment. Each chart was analysed, with the managers concerned, to evaluate evidence of biases; to generate potential improvements to the method; and to assess utility.

Strategy content identification

The approach helped to discern three aspects of strategy content. First, the historical comparative attention to different strategy decision areas; second, the development of strategy content over time; and third, repeated patterns

Comparator	Case 1	Case 2	Case 3	Manufacturing strategy
Industry	Jet engine components	Auto disc brake pads	Auto engine bearings	1075
Manufacturing sites	9	1	1	
Turnover at cost (\$M per year)	900	22.5	34	
Roles of those charting	Corporate staff developing and supporting a multi-site manufacturing strategy	Manufacturing, quality and engineering staff plus line supervisors in a single business unit	Manufacturing, quality, engineering, product development and human resources staff	
Charter's knowledge and experience of strategic concepts	Familiarity with business and manufacturing strategy research	Relatively low, the idea of manufacturing strategy was introduced by the researchers	Relatively low, the idea of manufacturing strategy was introduced by the researchers	Table I. Contextual case data

within particular content areas. The following examples illustrate these aspects.

Counting events as shown in Table II assessed the comparative attention to different content areas. Note that events covering multiple decision areas are counted within each decision area, thus the total decision area events in Table II is greater than the number of actual events. Note also that the number of strategies being pursued are far less than the number of events since one strategy usually consists of a group of events acted out over time. The table shows that over the period analysed "machinery", "human resource" and "quality policy" decision areas had received most attention. (Note that the term

Decision areas	"Higher" strategy levels	Manufacturing objectives	Manufacturing strategy development	Manufacturing strategy implementation	Total events
Machinery	1	12	6	33	52
Human resources	2	1	8	26	37
Quality policy	1	1	7	25	34
Material	3	3	3	10	19
Production control	2	4	2	8	16
Organization	4		2	6	12
Facilities	3	3	2	4	12
New product introduction		1		7	8
Other	7			1	8
Total	23	25	30	120	198

Table II.
Case 3 – event distribution over five year's history and six months plan

“machinery” was chosen by case 3 managers – it is equivalent to Hayes *et al.*'s (1988) “process technology”. Firm specific language for these decision areas was allowed in order to help wider local understanding of a chart.) However, such aggregated data fail to show the ebb and flow of events over time.

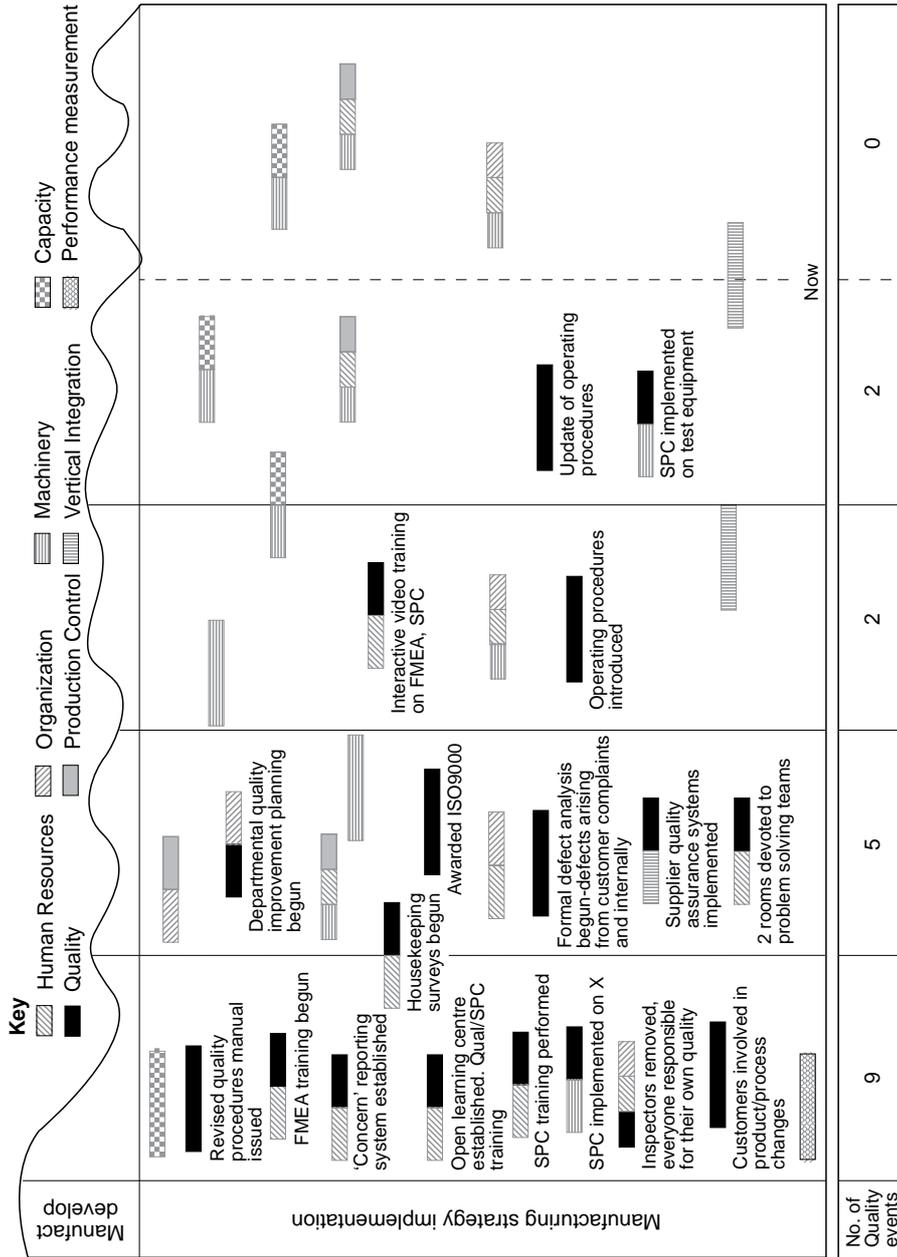
An analysis showing “quality policy” development over time is shown in Figure 2. This is an extract from case 3's strategy chart emphasizing events in the quality policy decision area at the manufacturing strategy implementation level. The quality manager supplied many of the events and the manufacturing managers were proud of their progress on quality, they described their strategy as total quality management. However, the count of quality policy implementation events, in Figure 2, showed how new initiatives had waned over time. To identify current quality strategy it was necessary to check whether past implementations were still in force, which in this case they were. Thus one interpretation of the count and content of these events concluded, “Current quality strategy is to live on past quality system implementations in predominantly production areas. No new initiatives planned”.

In the same case a very similar pattern could be seen in the “human resources” decision area where nearly all actions aimed at improving worker identification with the interests of the business (and its managers) routinely continued but new initiatives had ceased. One of the most important past innovations in this area had been visits of multi-function, multi-level groups to key customers. Although very well received at all levels these visits had ceased. The quality and human resource managers and their colleagues began to re-think their strategies.

A pattern within a decision area was evident in the apparently dominant decision area, “machinery”, comprising a series of capital investment decisions and implementations. These had all, it appeared, reduced cost though many had also improved quality and/or increased capacity. The pattern began to be noticed during chart construction – every equipment commissioning was accompanied by a manpower reduction. The strength behind these repeated manpower cost reductions became plain when the result of a recent SMED (single minute exchange of die) programme was measured by the number of skilled men saved. As far as the manufacturing managers had been concerned, market pressure to reduce lead times had been the driver for SMED activities. However, the CEO's strategy was to be a low cost, high quality producer and instead of reducing batch sizes and hence lead-times manpower cost savings had been preferred. His strategy was underpinned by a manufacturing engineering department (“organization” decision area) which reported directly to him and focused on manufacturing process improvement. Here strategy content seemed to be intertwined with organization structure and a strategy process dominated by a powerful CEO.

Strategy process

The representation of strategy chosen was deliberately biased toward manufacturing strategy content, yet patterns in content can indicate process



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Figure 2. Quality implementation events from case 3

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phenomena. It is no surprise that a company with separate manufacturing engineering and production functions should have “machinery” as a dominant strategy area – a group of engineers was generating new ways of reducing product cost as required by their CEO. However, charts can also inform other aspects strategy process:

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- Does manufacturing strategy link with objectives at business level and above?
- What were the sources of implemented strategies?
- How long did they take to implement?
- What strategies failed?

In all cases further process data was generated during and after charting where interpretations of how and why events had (or had not) occurred were discussed. Charts do not record this dialogue, but do allow perceived causal connections between events to be shown. Yet not every firm took advantage of this facility. In case 3 causal connections were discussed but seldom drawn since it was thought they made the picture “too busy”. In case 2 causal connections were frequently drawn, as if all events had been rationally planned. While in case 1, where their interest was to study their strategy process, connections were debated and tested before inclusion on the chart. However, beyond the observation that the approach generates significant strategy process discussion, which appears useful, we have come to no substantive conclusions on the chart’s merit or otherwise in this regard.

Strategy communication

The chart’s ability to assist in strategy communication might apply to those that created it or to those who view the completed result. For the former there was evidence that charting altered their perception of strategy in general and their strategy in particular.

In case 1 corporate strategists were interested in the way the chart showed linkages between different content areas:

The chart emphasises the holistic nature of strategy, analysing this decision area is almost meaningless without the context of other decision areas (Corporate strategist, case 1).

All managers seemed to find the notion of strategy as actions as well as objectives, and the importance of past actions, as well as future intentions, attractive. In cases 2 and 3 managers were not familiar with strategy theory, they were engaged firmly in line operations yet this was a view of strategy they felt they could use. Merely explaining Mintzberg and Water’s theory of “deliberate and emergent” strategy would probably have changed managers’ views of strategy as a theoretical notion. However, charting their own strategy had achieved something more. It provided a different perspective on their experience.

A recurring theme from case 2 was the chart’s ability to show how individual actions and thus individuals involved in those actions contributed to the whole.

For this reason, and because of the strength of the manufacturing director's commitment to informing and involving the workforce, an edited version of their chart (initially showing a year's history) was widely displayed. Shopfloor workers traced events to their apparent source and this led to the chart being covered by a Perspex sheet to protect it. This interest may have been caused by the chart's ability to show not only past action and future plan but to give an indication of what led up to these actions and therefore indicate why they occurred. One manager commented that the juxtaposition of actions completed and those planned somehow made planned actions more real, more likely to happen. Shopfloor workers were, however, not the only parties interested in the chart. In case 2 the marketing director requested chart copies to show senior customer representatives. He felt the detailed actions shown in the chart were convincing evidence of a substantial manufacturing commitment – a message he wished to promote. This chart was updated every six months over almost three years.

Interest in widely displaying a chart was not repeated in case 3. It was accepted that the chart communicated strategy well and in particular had identified how their espoused long-term quality and human resource strategies had run out of steam. However, the works manager believed that his organization was not ready for openly displayed charts and access was limited to those who had been involved in generating them. In case 1, their chart was circulated in a confidential report to corporate and plant managers since it contained vertical integration events that had significant implications for some plants.

Validity

Since managers move position regularly, some past events had to be checked with staff not normally involved in strategy making. This was especially so in case 2 where the manufacturing manager was relatively new to this role and supervisors filled information gaps. Such checks are likely to reduce the risk of "group-think" but are likely to be fortuitous and so cannot eliminate it. Also, though the methodology did not demand written records of events, it was usual to be shown hard copy records of especially significant events (case 1) and in case 3, unsurprisingly, past capital investment records were produced.

In cases 2 and 3 the few voiced disagreements on event descriptions were confined to events at "higher" strategy levels, usually (it seemed) because there was imperfect knowledge of the event even when it occurred. Indeed events at "higher" levels might be interpreted as the implemented events at these levels as perceived by the charters since they seemed rarely aware of formulation activities at these levels. In case 1 the chart was generated by two individuals and later checked and supplemented by a third – there were few voiced disagreements and the chart was distributed to all plant directors who voiced no contrary views.

Comprehensiveness

Examination of the charts and reflection with managers led to the identification of four general points *vis-à-vis* chart comprehensiveness:

First, strategy charts capture the dynamic of strategy – actions, not the assumptions that have remained stable and around which there has been no action. This is partly a disadvantage of allowing charters to choose a limited time span since long run strategy content phenomena can be missed. A typical example was the assumption to continue manufacturing in the current location – charters in cases 2 and 3 did not volunteer this as a part of their facility strategy. It was elicited when a dearth of facility events was noticed.

Second, the methodology encourages charters to concentrate on implemented strategy. Failed or discontinued strategies do not tend to emerge naturally. As one manager put it:

The chart seems to give a rosy view of our strategy – all the things we've done and achieved. What about those things we tried and failed at? (Charter, case 3).

Indeed the data in Table II suggest that there were three implementation events, on average, for every two formulation events – was this correct or were the number of formulation events de-emphasised by the methodology? The latter explanation may be more likely since the methodology concentrates on strategy as past and planned implementations. Even more likely it may be a combination of the methodology with reluctance by managers to be explicit on these matters. This limitation would be crucial if the intention was to represent the strategy formulation process. However, it was unlikely to affect the methodology's effectiveness in identifying current strategy except in one area. Some of the most powerful strategies concern what will not be done. Their implementation is achieved by not doing something, however, in cases 2 and 3 such events emerged. The power of these events may have ensured elicitation, one concerned with a long-standing and high-profile health and safety issue and another with the acceptance that this site would no longer take a particular kind of order. Yet there are likely to be more subtle events concerned with not doing that may form part of the cultural preferences of manufacturing organizations and which this methodology would not access.

Third, comprehensiveness is clearly dependent on knowledge and memory. The use of a group should help the comprehensiveness of the chart, particularly at the manufacturing strategy levels where their knowledge will be most complete. But the chart's comprehensiveness at higher strategy levels will be limited by the knowledge of those present and the willingness of the more senior managers to share their knowledge (Seely Brown and Duguid, 1991).

Fourth, comprehensiveness varies over time. In case 3, one event, the attendance of the manufacturing manager at a course organized by the corporate group, appeared on the original chart. During the transfer from Post-its to a CAD generated chart this event was removed at the manager's request. It was a particularly significant event since it appeared to lead to a stream of implementations (in the "human resources" decision area) broadly intended to increase the identification of workers' interests with company and management interests. Why he did this was never satisfactorily explained. When asked he put it down to modesty, though in this organization giving corporate

departments credit for anything was not encouraged. Perhaps original charts may be the most valid – before their impact on the organization's political context has been evaluated. However, edits are almost guaranteed when charts are intended for wider display. In case 1 the initial chart was edited from 97 to 59 events for inclusion in a report to those outside the charting group. In case 2 the first published chart included only one year's history and in case 3 managers were sure that events relating to a major industrial relations dispute would not be included if the chart was ever widely displayed.

Potential improvements

As well as reviewing the content of their charts managers also suggested potential improvements to the process of charting and the charts themselves:

- Charting with a group is an intensive activity and it is important to place events speedily. In case 3 the roles of facilitator, event description writer and checker for the strategy decision areas covered by events were distributed and rotated round the charting group. This speeded the process, ensured wide involvement and is now part of the method.
- It was suggested, by managers in case 1, that the strategy hierarchy should be inverted to suggest the primary importance of strategy implementation. This was not adopted by case 1 and is not used in the approach.
- The addition of a band of performance measures, below the implementation level, reflecting the performance of the unit over time was suggested. Although managers were free to do this none did and it has not been adopted in the approach.
- The addition of an external event level to the strategy hierarchy. This was not adopted since such events seemed to fit well at business or corporate strategy levels and within the manufacturing strategy formulation level. However, prompts to access external context are now included in the approach.

Preliminary conclusions and discussion

Our research objective was to test the utility, validity, and comprehensiveness of a pictorial method for the identification and communication of manufacturing strategy content. The wider context was to develop a strategy representation for use in a strategy development process. In this section we begin by summarising our preliminary conclusions and then discuss the role of the approach in that wider context.

The approach provides, within limits, an organization-specific record of manufacturing strategy content that is useful for identifying current strategy. In particular, representing manufacturing strategy as a pattern of actions appears to make "strategy" an understandable and communicable concept for manufacturing managers and workforce. Charts offer insight into the

longitudinal development of manufacturing strategy content in both qualitative and quantitative terms. Practitioners found the representation especially useful for analysing ostensibly long run strategies like empowerment and TQM, where decline in activity and changes in stance from pro-active to reactive and vice versa could be seen. Even with all reservations mustered the approach appears to help the identification of strategy content more fully than previous methods proposed by Fine and Hax (1985) or Platts and Gregory (1990) and more quickly than individual interviews, archive searches and subsequent analysis. Typically a chart is constructed in two enjoyable sessions of between two and three hours.

As a communication tool there is a paradox. The more detailed and thus explicit a strategy representation becomes the more barriers can emerge to restrict its wider communication. One organization seemed to find the chart's ability to communicate strategy its main strength (case 2) and updated it every six months while another (case 3) has yet to widely display even an edited version and may never update it. The evidence indicates that charts can be a more comprehensive strategy communication tool than more usual verbal and key word approaches.

There are criticisms of the approach concerning possible "group think" and the lack of reliance on documentary evidence for past events. However, the approach is primarily intended for managers. And for them how valid does the chart have to be? Weick suggests that validity is not particularly key, the prospect of order may be more important:

The important feature of a cause map (or any map) is that it leads people to anticipate some order "out there". It matters less what particular order is portrayed than that an order of some kind is portrayed. The crucial dynamic is that the prospect of order lures the manager into ill-formed situations that then accommodate to forceful actions and come to resemble the orderly relations contained in the cause map. The map animates managers, and the fact of animation, not the map itself, is what imposes order on the situation (Weick, 1985, p. 127).

From this perspective charts are merely a starting point for actions which try to impose order, given a prospect of order. They show order in the structure of their axes, in the definition of events and in the colours of decision areas. They make patterns over time accessible and invite managers to formulate, plan and place the next action.

Formulation activities seem to be de-emphasised and slow moving or implicit aspects of strategy content may be missed. Yet what method can ever be comprehensive for a fuzzy multi-dimensional construct like strategy? Nevertheless, improvements to the approach have been identified within the action research and some have been adopted, see earlier.

Although it is too early to evaluate the approach in a wider strategy process it has three relevant facets. First, such processes require an educational component and the approach has appeared to present an understandable view of strategy for those who must also implement it. Strategy making from this perspective is about thinking and implementation since strategies will be unrealised without the detailed grind of implementation. Second, it is often

emphasized that strategies need to be communicated well if they are to be implemented successfully – the approach can assist here though raw charts may communicate too well in some cultures. And finally, charts have a potential role to inform, or at least record, strategy formulation and formation actions and decisions in real time. Charts show parts of the context and process of strategy but the act of charting provokes considerable discussion on how past strategies arose; how long they took to implement; and which strategies failed and why. Charting may therefore be very useful in forming new strategy, especially if managers are prepared to learn from the past. We know little about this potential of the approach and further research is needed. If, however, manufacturing strategy is about choice and order of implementation of manufacturing systems (Clark, 1996) and/or about strategic trajectories and the building of manufacturing capabilities (Hayes and Pisano, 1996), representations which show the development of strategy over time should become more important.

What remains clear is that managers need critically tested and theoretically grounded approaches to assist their ongoing strategy formulation and formation. We have proposed a theoretically grounded, pictorial way of representing a firm's manufacturing strategy. Instead of using a questionnaire, observation or interview we have specified a structured picture and a method of constructing it. We tested the method and improved it in an action research setting, exposing biases found in the picture and in the method of construction. Coincidentally or not the approach calls on managers to mimic researchers, as Mintzberg and Waters speculated:

A major component of that elusive concept called "strategic control" may be in managers doing what we do as researchers: searching for patterns in streams of organizational actions. Pattern recognition is likely to prove a crucial ability of effective managers and crucial to effective organizations may be the facilitation of self-awareness on the part of all its members of the patterns of its own actions and their consequences over time (Mintzberg and Waters, 1985, p. 272).

Charting is a small step in the direction of facilitating that self-awareness, promoting sensitivity to an organization's history and exploring the dynamics of its strategy development.

Finally, though the charting approach was intended for managers, it is clear to us that visual methods of gathering and structuring data are of value to researchers working in organisations. The resulting picture and the rich discussion it provokes may be equally useful to managers and researchers. We encourage strategy researchers to bear in mind that there are many possible pictures of strategy and consider that one might help their research.

References

- Adam, E.A. and Swamidass, P.M. (1989), "Assessing operations management from a strategic perspective", *Journal of Management*, Vol. 15 No. 2, pp. 181-203.
- Anderson, J.C., Cleveland, G. and Schroeder R.G. (1989), "Operations strategy: a literature review", *Journal of Operations Management*, Vol. 8 No. 2, pp. 133-58.

- Chakravarthy, B.S. and Doz, Y. (1992), "Strategy process research: focusing on corporate self-renewal", *Strategic Management Journal*, Vol. 13, pp. 5-14.
- Checkland P., Warmington A. and Wilson B. (1983), "Research on improving the management of production systems: an approach through systems methodology", in Wilson, Berg and French, *The Efficiency of Manufacturing Systems*, NATO ARI Series, Plenum, New York, NY.
- Clark, K.B. (1996), "Competing through manufacturing and the new manufacturing paradigm: is manufacturing strategy *passé*?", *Production and Operations Management*, Vol. 5 No. 1, pp. 42-58.
- Fine, C.H. and Hax, A.C. (1985), "Manufacturing strategy: a methodology and an illustration", *Interfaces*, Vol. 15 No. 6, pp. 28-46.
- Golden, B.R. (1992), "The past is the past – or is it? The use of retrospective accounts as indicators of past strategy", *Academy of Management Journal*, Vol. 35 No. 4, pp. 848-60.
- Hayes, R.H. and Pisano, G.P. (1996), "Manufacturing strategy: at the intersection of two paradigm shifts", *Production and Operations Management*, Vol. 5 No. 1, pp. 25-40.
- Hayes, R.H. and Wheelwright, S.C. (1984), *Restoring our Competitive Edge*, John Wiley, New York, NY.
- Hayes, R.H., Wheelwright, S.C. and Clark, K.B. (1988), *Dynamic Manufacturing*, Free Press, New York, NY.
- Hickson, D.J., Butler, R.J., Cray, D., Mallory, G.R. and Wilson, D.C. (1986), *Top Decisions: Strategic Decision-making in Organisations*, Basil Blackwell, Oxford.
- Hofer, C.W. and Schendel, D. (1978), *Strategy Formulation: Analytical Concepts*, West Publishing, St Paul, MN.
- Huber, G.P. and Power, D.J. (1985), "Retrospective reports of strategic-level managers: guidelines for increasing their accuracy", *Strategic Management Journal*, Vol. 6, pp. 171-80.
- Huff, A.S. and Fletcher, K.E. (1990), "Conclusion: key mapping decisions", in Huff, A.S. (Ed.), *Mapping Strategic Thought*, John Wiley, Chichester.
- Janis, I.L. (1979), *Decision-making: A Psychological Analysis of Conflict, Choice and Commitment*, Collier Macmillan, London.
- Meyer, A.D. (1991), "Visual data in organizational research", *Organization Science*, Vol. 2 No. 2, pp. 218-36.
- Mintzberg, H. and Waters, J.A. (1982), "Tracking strategy in an entrepreneurial firm", *Academy of Management Journal*, Vol. 25 No. 3, pp. 465-99.
- Mintzberg, H. and Waters, J.A. (1985), "Of strategies deliberate and emergent", *Strategic Management Journal*, Vol. 6, pp. 257-72.
- Pettigrew, A.M. (1992), "The character and significance of strategy process research", *Strategic Management Journal*, Vol. 13, pp. 5-16.
- Platts, K. and Gregory, M.J. (1990), "Manufacturing audit in the process of strategy formulation", *International Journal of Operations and Production Management*, Vol. 10 No. 9, pp. 5-26.
- Platts, K., Mills, J.F., Neely, A.D., Gregory, M.J. and Richards, H. (1994), "Evaluating manufacturing strategy formulation processes", *8th International Working Seminar on Production Economics*, Austria, February, pp. 351-65.
- Schroeder, D.M., Congden, S.W. and Gopinath, C. (1990), "Illuminating the blind spot: examining linkages between manufacturing technology and competitive strategy", in Ettl, J.E., Burnstein, M.C. and Fiegenbaum, A. (Eds), *Manufacturing Strategy: The Research Agenda for the Next Decade*, Kluwer Academic, Norwell, MA.
- Schwenk, C.R. (1985), "The use of participant recollection in the modeling of organizational decision processes", *Academy of Management Review*, Vol. 10, pp. 496-503.

- Seely Brown, J. and Duguid, P. (1991), "Organizational learning and communities-of-practice: toward a unified view of working, learning and innovation", *Organization Science*, Vol. 2 No. 1, pp. 40-57.
- Skinner, W. (1969), "Manufacturing – missing link in corporate strategy", *Harvard Business Review*, May/June.
- Skinner, W. (1996), "Manufacturing strategy on the 'S' curve", *Production and Operations Management Journal*, Vol. 5 No. 1, pp. 3-13.
- Susman, G.I. and Evered, R.D. (1978), "An assessment of the scientific merits of action research", *Administrative Science Quarterly*, Vol. 23, December.
- Swamidass, P.M. (1986), "Manufacturing strategy: its assessment and practice", *Journal of Operations Management*, Vol. 6 No. 4, pp. 471-84.
- Weick, K.E. (1985), "Sources of order in under-organized systems: themes in recent organizational theory", in Lincoln, Y.S. (Ed.), *Organizational Theory and Inquiry*, Sage, Beverly Hills, CA.