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Visual Strategizing

The Systematic Use of Visualization in the Strategy Process

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Keywords

Abstract

In this article, we examine the use of visual representations for the business strategy process (from strategic analysis and strategy development to strategic planning and implementation). Starting with a review of literature, we show that visualization can address many of the cognitive, social, and emotional challenges of the strategy process, if visualization is understood as a participatory process and as interactive communication rather than as a static graphic rendering of outcomes. We categorise and position feasible methods that are based on the interactive visual representation of information along the strategy process and highlight their benefits. A conceptual framework and six corporate case studies illustrate how to use strategy visualization systematically. In the conclusion of the article we highlight the potential risks of visualization for strategizing and articulate a research agenda for this emergent domain.

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Introduction

Strategic thinking is among the most demanding tasks that managers face in today's complex market place. It can be an overwhelming challenge to take into account, simultaneously, the developments of technologies and societal trends, the behaviour of competitors, customers and regulators, all within a changing legal, environmental and financial framework. When this is compounded with time pressures, uncertainty and constant distraction and internal tensions it becomes an immense challenge to make sound and sustainable decisions. This challenge is made even more difficult by the subsequent need to communicate, implement, and monitor these decisions in a systematic, orchestrated and disciplined manner. Taken together, these activities pose numerous *cognitive* (e.g. information overload), *emotional* (e.g. achieving staff buy-in) and *social* (e.g. co-ordinating multiple groups and hierarchic levels) challenges for a business manager (see also Roos & Bürgi, 2003, p. 77, Roos et al. 2004, p. 556 for this distinction). The visual representation of information, on the other hand offers many cognitive (e.g., overview), emotional (e.g., inspiration) and social (e.g., common focus) advantages that can be put to use in the business strategy process. In the following, we will substantiate this claim by reviewing the state-of-the-art in the strategy visualization area and by reporting on implementation experiences with different visual methods in the analysis, development, planning, and implementation phases of business strategizing. Specifically, we answer four key questions regarding strategy visualization: Why? When? What? and How?

1.   Why should managers use visual methods? What are the benefits that they can achieve by applying them?

To answer this question, we discuss the main cognitive, social and emotional benefits of visualization, based on seminal empirical visualization studies, and match them with corresponding strategy challenges, as they have been documented in the relevant strategy literature.

2.   When should managers use visualization methods in the strategy process? In other words: In which situations should managers make use of which type of visualization?

To answer this question, we position different visual templates, frameworks and methods along the strategy process based on their benefits and the requirements of each step in the strategy process. We argue that visualization should not be used as an end-of-the pipe solution

to make strategic decisions more accessible, but rather as a constant process catalyst that can improve analysis, decision making and communication.

3.   What visualization-based methods can be tailored to strategizing? They must be easy-to-use, and have proven benefits.

To answer this question, we present an overview on interactive visual methods that can be applied to strategizing and we present new visual strategizing methods that we have developed in co-operation with various corporations.

4.   How should managers use these interactive visualization methods? What are some of the challenges and pitfalls of using graphic methods in strategizing?

Based on the experiences with visualization methods in six organizations, we list key requirements and caveats for the use of visual methods in strategizing. We present a management framework that can guide executives in the application of visualization methods throughout the strategy process. In the final part of the article we discuss potential disadvantages and risks of using visualization in strategizing.

The Need for Strategy Visualization

Why should executives be interested visualization? Why should they view visualization as a strategy enabler rather than the simple graphic form they give to their decisions and plans? Table 1 relates key challenges in the strategy process to key advantages made possible by information visualization. This illustrates the benefits that methods which employ graphic representations of strategic content offer for the entire process of strategizing. As mentioned in the introduction, we distinguish between challenges related to managerial thinking (cognitive challenges), managerial communication and coordination (social challenges), and the managers' ability to motivate and engage their peers and employees (emotional challenges). We consider both the context of strategy development (incl. analysis and planning) and the context of strategy deployment (incl. controlling). The following table shows for which types of challenges visualization can provide value.

Characteristics of Strategizing	Corresponding Strengths of Visualization
1) Cognitive Challenges	**1) Cognitive Benefits**
Strategic analysis creates a massive amount of information that is difficult to absorb by any individual manager or group (Leaderer and Sethi, 1996).	Miller (1956) reports that a human's input channel capacity is greater when visual abilities are used.
Strategy development and implementation confronts managers with numerous complex problems (Sabherwal and King, 1995)	Improves problem solving (Vessey 1991)
The development of strategic options often requires novel perspectives (de Wit & Meyer, 2004, pp. 58-70)	Visual methods enable reframing and perspective switching (De Bono 1973).
Requires the detection of patterns among great quantities of information (Brown & Eisenhardt, 1998)	Our brain has a strong ability to identify patterns, which is examined in Gestalt psychology (Ellis, 1938, Koffka, 1935).
Strategy development puts high demands on managers' divergent, creative thinking (de Wit & Meyer, 2004, pp. 58-70)	Pictures have been shown to inspire creativity and imagination. (Buzan 2003, Morgan 1986)
Strategy development and formulation requires collective sense making processes (Digman, 1990)	Facilitates sense-making (Smith and Fiore 2001)
Requires input and contributions from various members of teams (Platts et al, 1996)	Visualization can equilibrate participation and reduce the dominance of certain participants (DiMicco et al. 2004)
Developing a strategy requires the in-depth analysis of data (Markides, 1999, Kaplan and Norton, 2000).	Visualization is instrumental in the analysis of data as it helps in identifying patterns and structures in data sets (Card et al., 1999; Tufte, 1983, 1990; Bertin, 1983)
Strategic information may be forgotten amidst new information pertaining to daily operations (Porter 1996, Mintzberg et al. 1999)	Visual images help information recall about the current strategic conversations (Kraut, et al. 2003). Kosslyn, 1980, Shepard and Cooper, 1982, suggest that visual recall seems to be better than verbal recall.
In strategizing managers need to acquire new knowledge quickly and integrate it with their existing knowledge (Leaderer and Sethi, 1996, Hull and Wu, 1997).	Instructional psychology and media didactics investigate the learning outcome in knowledge acquisition from text and picture (Mandl and Levin, 1989), or Weidenmann (1989), who explores aspects of illustrations in the learning process.
Information has to be combined and conclusions need to be derived through inferential processes.	Visualization facilitates inference processes (Larkin and Simon 1987)
Requires managers to make difficult decisions which they may postpone (paralysis by analysis/knowing-doing gap) (Pfeffer & Sutton, 2000)	Facilitates the decision making process (McKim 1972) Foil and Huff (1992)
Many factors have to be considered at the same time (Eisenhardt, 1989)	Visualization expands working memory (Norman 1993)
Requires comparison of multiple strategic options based on various parameters (Digman 1990, De Wit and Meyer 2004)	Several empirical studies show that visual representations are superior to verbal sequential representations in different tasks (Bauer and Johnson-Laird, 1993, Glenberg and Langston, 1992, Larkin and Simon, 1987).
2) Social Challenges	**2) Social Benefits**
The strategy needs to be communicated to employees convincingly (Digman 1990, Pearce and Rombinson, 1988, Acur and Bitici, 2003)	Visualization is ideally suited for communication and presentation purposes (Horn, 1989)
Managers need to assure that their reasoning is properly understood by the employees (Digman, 1990).	Visual metaphors provide a visual means to assure mutual understanding (Morgan, 1986)
Identify where managers disagree about fundamental basic assumptions regarding the future of their business (Foil and Huff , 1992).	Visualization can surface areas of disagreement (Sparrow, 1998)
Strategizing needs mechanisms to ensure coordination, both in communication and in action (Acur and Bitici, 2003).	Visual artefacts provide explicit reference points for mutual coordination and alignment (Bechky, 2003).
Strategic co-ordination becomes difficult when management teams are globally dispersed (Zigurs, 2003)	Visualization methods combined with application sharing software make it possible to simulate strategy workshops via the Internet (Mengis and Eppler, 2006)
3) Emotional Challenges	**3) Emotional Benefits**

All involved managers should be able to identify with the strategy process and result and feel involved (Godet 1998).	Pictures can create involvement and engage people's imagination (Buzan 1995, Huff, 1990).
Differences of opinion regarding the strategy in a management team may escalate into personal conflicts (Eisenhardt et al. 1997)	Visually facilitated strategy discussions lead to a more productive handling of conflict (Mengis & Eppler, 2006).
Employees should perceive the strategy as something worthwhile pursuing, something they can identify with, and something that motivates them (Platts et al. 1996, Godet, 1998).	Pictures can inspire motivation and identification; they can release positive emotions and energy (Buzan, 2003).

Table 1: Strategizing Challenges and corresponding strengths of visualization

Table 1 illustrates how (and where) visualization can provide benefits to the strategy process. The following section discusses how to systematically harness these benefits. We develop Henry Mintzberg's (2005) insight that strategic thinking can be conceived as different kinds of *seeing*, such as seeing from above (i.e. analysing the entire market environment), seeing from below (i.e., mining or analysing internal data), seeing ahead (i.e. planning and forecasting), seeing besides (benchmarking), or seeing things through (i.e. implementing the strategy). We argue that this visual view of strategy is a productive metaphor that can be supported through four types of visualization methods that need to be applied along the strategy process. Seeing (or mapping as pointed out by Christensen (1997) or Kaplan and Norton (2000)), however, is not just, as we will see below, a useful metaphor for strategic thinking, it can also support the process of strategy communication and implementation.

A Framework for Visualization in the Strategy Process

Having shown in the previous section that visualization can provide numerous benefits for the process of developing and deploying a business strategy, we will now look more closely at which points of the strategy process this can be done. In this section we synthesize our previous observations in a management framework consisting of four levels. This framework should help managers in applying visualization to the strategy process and it should provide a structure in which management researches can position the methods that they have developed. We then illustrate the framework through six real-life case studies.

Our framework for strategy visualization is based on the four previously identified questions that a manager has to address in order to use visualization for strategizing. These questions relate to the strategic situation in which the visualization is used (when?), the type of strategy content that is represented (what?) the expected visualization benefits (why?) for

strategizing, and the actual visualization format used in a particular strategy phase (how?). These four levels or perspectives are represented in the diagram below.
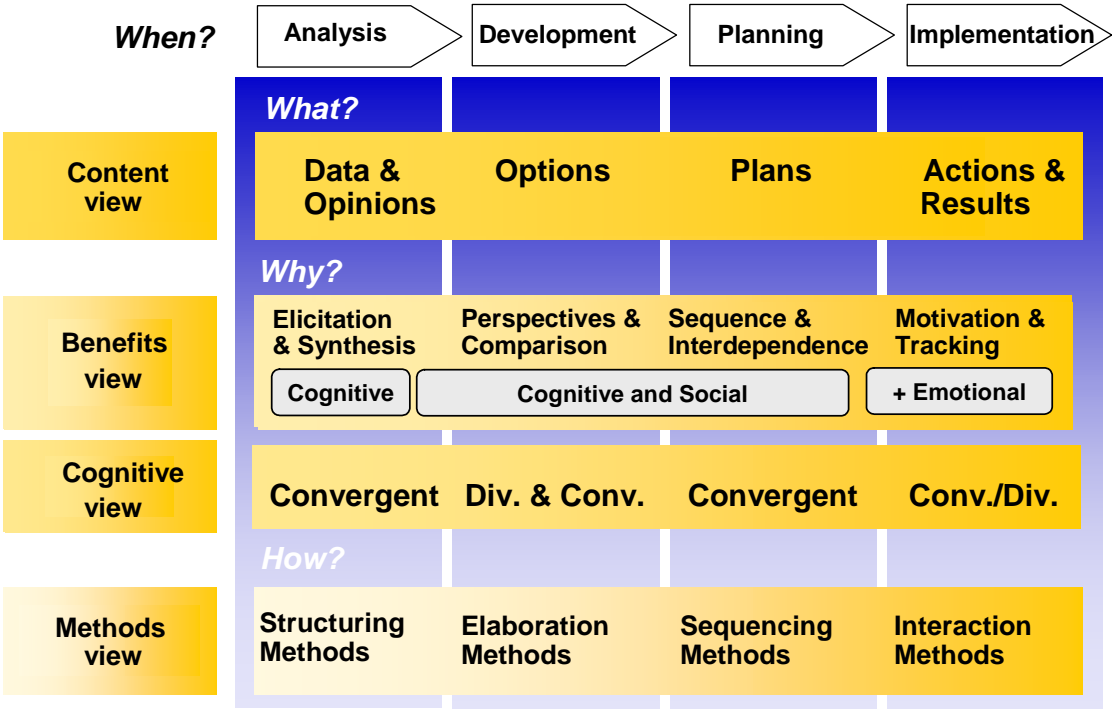
Figure 1: A Framework for Strategy Visualization

Below, we briefly describe each view and its components and provide typical examples for each phase in the strategy process.

Content View

In terms of content that is used or generated during each phase of the strategy process, our framework highlights four main types of information along the four main steps of strategizing.

In the analysis phase visualization mostly serves the purpose of representing and synthesizing quantitative and qualitative *data* about the company and its environment. In addition to this gathered data, visualization should also be helpful to make *opinions*, basic assumptions, and implicit understandings explicit and accessible to the managers involved in the strategy process. Typical data that may have to be visualized during this phase are sales and market statistics, as well as internal indicators regarding past events and developments. Opinions that should be visually represented include assessments about market threats and opportunities, as well as internal strengths and weaknesses.

In the strategy development phase, visualization aids the generation of *options* for action. These options include potential strategic goals, milestones, activities and possible resource deployments. By visualizing all feasible options and their parameters, they can then be more easily assessed, selected, and operationalized in the subsequent planning phase.

The core content of the planning phase is obviously *planning information*. This includes timelines, resource allocations, responsibilities and deliverables. The visualization of the planning information can also be helpful in the subsequent implementation phase.

In the implementation phase, *actions* (and their relationships) and *results* should be visualized. Actions may be departmental projects, strategic initiatives of a business unit, or the required behaviour patterns of individual employees. The *results* of these actions are typically captured in key performance indicators and provide valuable feedback to management whether strategic progress is made or not.

Benefits View

The benefits view summarizes the main advantages that can, and should, be achieved with visualization along the four main steps of the strategy process. In terms of visualization benefits, we distinguish between cognitive, social and emotional benefits of visualization. In the analysis phase, visualization is most valuable because of its cognitive benefits. Specifically, visualization enables managers to process more data (through its *synthetic* ability) and avoid information overload and subsequent mental shortcuts or cognitive biases (Das & Teng 1999). In addition, visualization can be used to *elicit* the implicit mental models of managers and align the assumptions present in a management team (see for example Huff 1990).

In the strategy development phase, the greatest benefit of visualization is twofold: firstly, it can enable the re-framing of current views and foster a change in perspectives (for example by switching levels of analysis or time horizons or by visualizing issues from an outside view); secondly, visualization facilitates the systematic and global *comparison* of many options (both cognitive benefits). Already in this phase, the social, co-ordination function of visualization plays an important role, by enabling a transparent and focused discussion and prioritization of the developed options (for example by managers commenting and moving options on a joint rating matrix during a workshop).

In the planning stage, the social function of visualization becomes crucial. The main benefit of visualization in this stage is to provide an overview of the planned *sequence* of goals and steps that can be easily communicated. This overview can also lead to new insights regarding possible positive or negative *interdependencies* among goals or implementation steps.

In the final stage, implementation, the great strength of visualization is that it can trigger positive emotions and *motivate* the workforce through engaging images and inspiring symbols. Besides this emotional benefit of motivation, it also offers cognitive and social advantages in the implementation phase. It can be used to visualize progress in real-time and highlight areas where the strategy implementation may not be going smoothly. In this way, managers can visually track the progress of the implementation process (for example, through a graphic dashboard of key implementation indicators).

Cognitive View

Mintzberg et al. (1976, 255) identified two cognitive thinking styles essential for strategic decision making, namely divergent (creative/expansive) thinking and convergent (analytic/reductive) thinking. Visualization has been shown to greatly assist both types of thinking (Rhodes 1994), although different forms of visualization are required for each. In the strategic analysis phase, managers can employ information visualization methods that structure a great amount of information in an ordered way, so that (*convergent*) synthesis and inference processes become possible. In the strategy development phase, by contrast, visualization methods should first support *divergent* thinking in order to assist managers in the development of a great variety of feasible options and scenarios (i.e., visual brainwriting). This multitude of options can then be assessed and combined with more *convergent* visualization tools (for example morphological boxes). In the planning stage, *convergent* thinking along a time axis becomes paramount. Here visualization can assist managers in focusing on a reasonable sequence of goals and actions. In the implementation stage, firstly creative, *divergent,* thinking is needed in order to capture the employees' attention and imagination and to create buy-in for the new strategy through original and informative ways of communicating it. A new strategy that uses old, clichéd ways of communication may run the risk of indifference or cynicism on the part of the employees. Finally, *convergent* thinking is needed to enable managers to track strategic progress and quickly identify deviations from the plan.

Methods View

The methods view distinguishes among four types of visualization methods that are used along the strategy process. Each method type is aligned to a phase in the strategy process and represents a different genre of strategy visualization. These four main genres are based on the reasoning outlined in the previous sections (i.e. they provide specific social, cognitive or emotional benefits for each phase). The following table provides an overview and description of each type and lists typical visualization format examples. The table also relates each visualization genre to Mintzberg's modes of 'strategic seeing'. The categorization of the visualization formats should, however, not be seen as absolute. Sometimes, it may makes sense to apply sequencing methods in the analysis phase (for example to re-construct an emergent strategy), or use a structuring method in the implementation phase to communicate the status-quo to employees.

Visualization Method Type	Main Features	Examples of Typical Visual Formats	Supported Strategic Seeing Modes
Structuring Methods (Analysis Phase)	Provide a ready-to-use structure (incl. categories) to organize and synthesize information	Bar diagram, line chart, system / loop diagram, 2by2 positioning matrices (BCG, McKinsey, SWOT), Porter's five forces diagram, S-curve diagram, strategy chart, product-market diagram	Seeing behind, seeing below, seeing beside
Elaboration Methods (Development Phase)	Provide rules and a relatively open structure to elaborate on information, discover new patterns, build a common understanding and develop options	Decision tree, Ansoff matrix, morphological box, knowledge map, concept map (Novak), Mind Map (Buzan), Parameter Ruler, influence diagrams, strategy canvas (Kim & Mauborgne 2002)	Seeing above, seeing beyond
Sequencing Methods (Planning Phase)	Provide rules, categories and graphic structures to organize information, such as tasks or goals, chronologically to prepare action	Timeline, flowchart, Gantt chart, roadmapping, CPM diagram (critical path method), PERT diagram, swimlane diagram, Nassi-Shneiderman diagram, Synergy Map	Seeing ahead
Interaction Methods (Implementation Phase)	Provide an interface to capture, aggregate, present and explore information.	Management controlling dashboard/cockpit, Strategy Map (Kaplan & Norton 2000), visual metaphors, tracking diagrams such as flight plans	Seeing through

Table 2: Four genres of strategy visualization methods

Having described the rationale of our framework, we can now examine how these visualization formats provide the stipulated benefits for real-life strategizing and which contextual factors need to be taken into account when deploying them in a corporate setting.

Case Studies and Application Experiences

In this section we report on the practical experiences with the systematic and consistent use of visualization in strategic processes. We present at least one case for each of the four phases in the strategy process and report on the deployed methods, the visualized content, and – most importantly – on the positive and negative impacts of using visualization in that strategic situation.

The following table gives an overview and preview of the case studies. They have been compiled through participatory observation and action research in Great Britain, Switzerland and Germany. The researchers who have documented these case studies also acted as facilitators for the described strategy processes.

Each case study is based on a collaboration of several months and includes multiple sources. Besides workshop feedbacks, document analysis, and follow-up interviews, observations were cross-checked between at least two researchers. Before the context of each corporation is described we briefly list the strategic phase that is presented, the level of strategizing, as well as the primary strategic content and thinking types required. We also state the main benefit of visualization in the case, and the visual format that was used during that phase.

Case:	Strategic Phase	Level of Strategizing	Industry & Size	Deployed Visualization Methods	Key Insights of the Case
Case 1	Analysis	Business Unit	-Car components manufacturer -medium-sized company part of an inter-national group	Strategy Charting	The mapping process itself can spark insightful discussions and lead to new strategic opportunities if the executives are open minded and compile a balanced strategy chart.
Case 2	Analysis	Business Unit	-Manufacturing Service Provider -Medium-sized company	Product-Market Network Diagram	The visual depiction of individually known facts or held beliefs can lead to new collective insights that can lead the way to strategic improvements.
Case 3	Analysis and Development	Company	-Reinsurance -Multi-national group	-Joint Rating Ruler -Client Strategy Ruler	Individual strategic assessments must be combined in a transparent and flexible way in order to devize joint strategic action plans.
Case 4	Development and Planning	Department	-Polymer manufacturer	TAPS	Cause-effect visualization helps to prepare action planning if all participants can see and subsequently agree on the identified relationships of key strategic variables.
Case 5	Planning & Implementation	Department	-Financial Services - Multi-national Group	Synergy Map	The visualization method must be transformed into a personal working tool and revized and updated on several occasions. It should become an organizational routine.
Case 6	Implementation	Company	-Market Research -Medium-sized company in a multinational group	Balanced Scorecard Tree	Appealing and engaging strategy visuals must be easy, interactive and allow for zooming in and out. They should contain memorable and inspiring symbols or metaphors.

Table 3: Overview of the reported case studies

CASE 1:

Analysing Manufacturing Strategy at a Manufacturer of Automobile Components

Strategy phase: Analysis

Level: Business Unit

Primary content: Objectives, Plans, Actions

Thinking types: Mostly convergent

Main benefits of visualization: Cognitive (overview and sequence), social (communication and alignment)

Visual format used: Structuring (and sequencing) technique: strategy charting

Company Context and Strategic Situation

A company, a manufacturer of auto components that was part of an international group, had recently reorganized into business units. The director of one business unit required a *review of the current manufacturing strategy* and its alignment with business needs. He wished this review to also act as a team building exercise to consolidate a new team in a newly created, stand-alone business unit. The visual technique of *strategy charting* (Mills et al. 1998) was used for this review. A strategy chart was created over a couple of 2-hour lunchtime work-shops. The chart was perceived to be such a useful way of introducing order into plans and activities that had occurred and were occurring, that it was decided to place a copy on the shop floor for communication purposes and to update the chart on a regular basis. This activity continued for three years before being discontinued.

Method Description: Strategy Charting

A strategy chart is a simple to use technique that captures activities and events that illustrate planned and emergent strategy. It gives users a common understanding of past, present and future strategy within their organization. The visualization uses colour, text and organized space to record and display information in a readily understandable form. For more detail see, for example, Mills et al. (1998). The basic chart is constructed on sheets of flipchart paper attached to the wall. Time is represented along the horizontal axis, and the various levels of strategic decisions and actions are represented on the vertical axis (see figure below).

	Time	
Business Unit Objectives		
Manufacturing Objectives		
Manufacturing Strategy Formulation		
Manufacturing Strategy Implementation		

Figure 2: A blank strategy chart with vertical axis suitable for a manufacturing context

Typically a chart is constructed in two sessions of between two and three hours. Participants in the charting session write decisions and events on stick-on notes and position them on the chart. Different colours of note can be used. In manufacturing companies each colour of note represents a particular decision area, e.g. suppliers, processes, quality. Events to be placed on the chart should be brief, factual descriptions of verifiable objectives, decisions and actions. Each should include a date to the nearest quarter. Examples: "CEO went to a conference and heard about Lean Manufacturing, Q2 1996". "Corporate requirement to reduce overhead, Q3 1995". "Decision to replace machine tool X, Q1 1998". The diagram below shows such one resulting strategy chart from such sessions with the company.
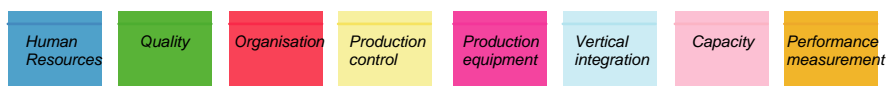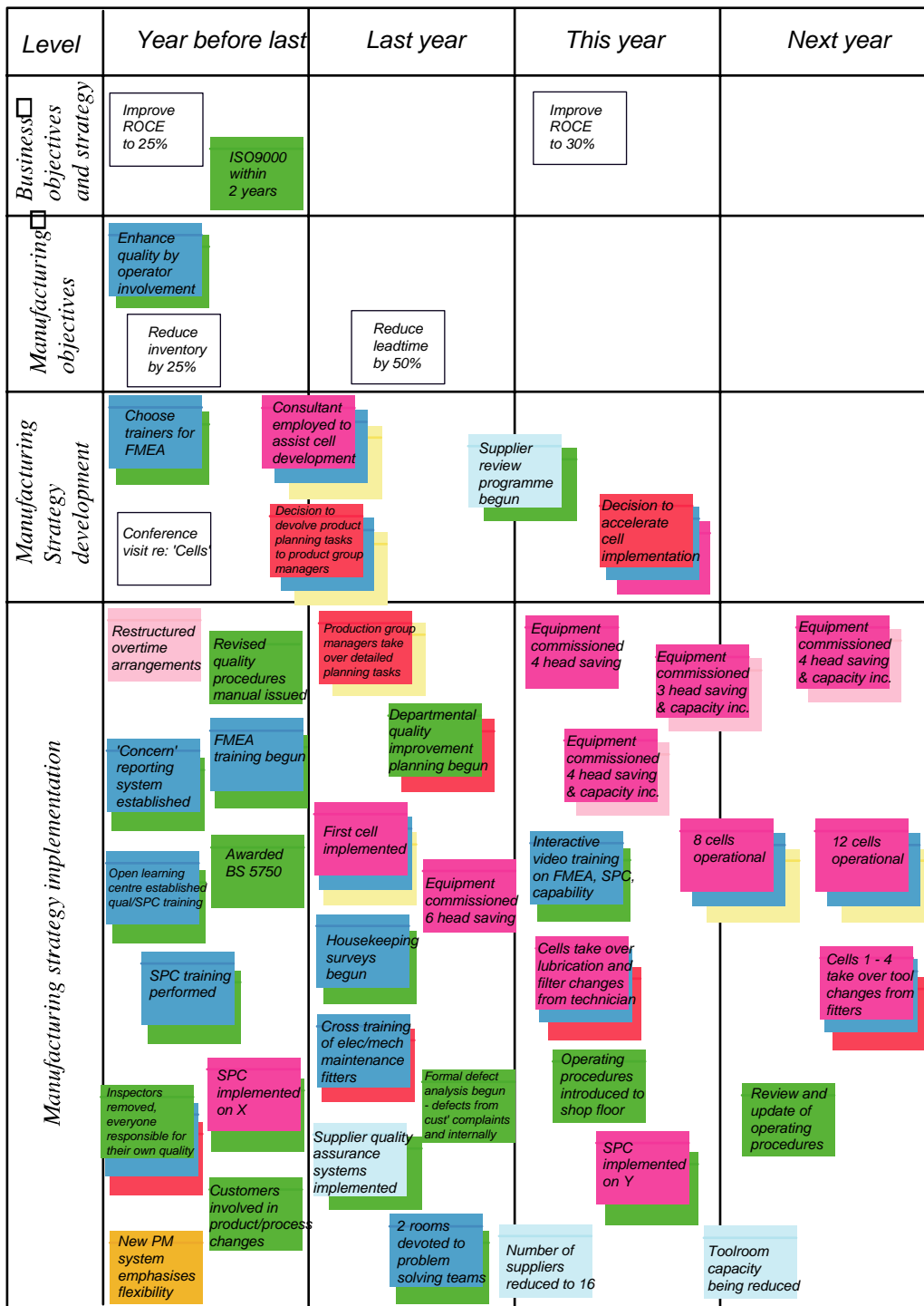
Figure 3 — Strategy chart (Implementation part) of the auto components manufacturer

Level	Year before last	Last year	This year	Next year
Business objectives and strategy	Improve ROCE to 25%; ISO9000 within 2 years		Improve ROCE to 30%	
Manufacturing objectives	Enhance quality by operator involvement; Reduce inventory by 25%	Reduce leadtime by 50%		
Manufacturing Strategy development	Choose trainers for FMEA; Conference visit re: 'Cells'	Consultant employed to assist cell development; Decision to devolve product planning tasks to product group managers	Supplier review programme begun; Decision to accelerate cell implementation	
Manufacturing strategy implementation	Restructured overtime arrangements; Revised quality procedures manual issued; 'Concern' reporting system established; FMEA training begun; Open learning centre established qual/SPC training; Awarded BS 5750; SPC training performed; SPC implemented on X; Inspectors removed, everyone responsible for their own quality; Customers involved in product/process changes; New PM system emphasises flexibility	Production group managers take over detailed planning tasks; Departmental quality improvement planning begun; First cell implemented; Equipment commissioned 6 head saving; Housekeeping surveys begun; Cross training of elec/mech maintenance fitters; Formal defect analysis begun - defects from cust' complaints and internally; Supplier quality assurance systems implemented; 2 rooms devoted to problem solving teams	Equipment commissioned 4 head saving; Equipment commissioned 3 head saving & capacity inc.; Equipment commissioned 4 head saving & capacity inc.; Interactive video training on FMEA, SPC, capability; 8 cells operational; Cells take over lubrication and filter changes from technician; Operating procedures introduced to shop floor; SPC implemented on Y; Number of suppliers reduced to 16	Equipment commissioned 4 head saving & capacity inc.; 12 cells operational; Cells 1 - 4 take over tool changes from fitters; Review and update of operating procedures; Toolroom capacity being reduced

Legend: Human Resources | Quality | Organisation | Production control | Production equipment | Vertical integration | Capacity | Performance measurement

Figure 3: Events on the Implementation part of the strategy chart of the auto components manufacturer

Events may also be connected – if any events are thought to lead to other events they can be joined by arrows. Thus the chart can:

- 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.

Evaluation

The main advantage of the strategy charting procedure is that it provides managers with an agreed understanding of the evolution and current status of their manufacturing strategy. It makes 'strategy' an understandable and *communicable* concept for manufacturing managers and workforce. By offering an insight into the longitudinal development of manufacturing strategy, Strategy Charts can also form a starting point for future strategizing.

There are, however, difficulties to be overcome. There may be a tendency when charting to omit certain events, or to sanitize them, particularly in politically sensitive areas. There might also be attempts to post rationalize connections to make the strategic story look more logical. In order to minimize these effects careful facilitation is required. For example, gathering all the events onto the chart before looking for linkages, and allowing plenty of time to capture contributions before analysis, are helpful techniques. A further difficulty can arise if the strategy chart is created in a group where one individual is clearly dominant. This can lead to a type of group think where individuals' opinions become suppressed. One way around is to get individuals to present their contributions in an anonymized way before group discussion.

Case Learnings

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 a new strategy, especially if managers are prepared to *learn from the past* (i.e., missed opportunities, exaggerated optimism, successful developments or missed follow-ups). Users need to be sensitive to the dangers of groupthink, selective memory, (i.e., only recalling successful events, or events that fit a participant's model of reality) and post rationalization (introducing non-occurring linkages and planning activities to make the strategy appear rational) and to encourage openness in the construction of the chart. Good facilitation in the use of the visualization is crucial here.

CASE 2:

Identifying Profitable Revenue Streams at a Manufacturing Service Provider

Strategy phase: Analysis

Level: Business Unit

Primary content: Factual information.

Thinking types: Convergent

Main benefits of visualization: Cognitive (structuring); Social (achieving agreement)

Visualization format used: Network diagram

Company Context and Strategic Situation

This case was a part of an engagement with an engineering company that had recently started providing testing and maintenance services in a separate business unit. The main objective of the engagement was to conduct a diagnostic review of the business unit's strategy and operations. The diagnostic process consisted of four stages: (1) strategic analysis, (2) functional diagnostic, (3) implementation planning and (4) execution. A key step in the first stage of the process was the identification the company's revenue streams. The company was generating revenues by offering a wide array of services to a diverse group of customers. A Product-Market Network (PMG) Diagram was developed to analyze the structure of the company's revenue streams and identify opportunities and develop strategic alternatives.

Method Description: Product Market Group Network Diagram

The PMG Network Diagram is essentially a connectance diagram examples of which can be found in various different fields such as operations research and computer science. Connectance diagrams are used to visually represent relationships (edges) between the elements of a system (nodes). A PMG network diagram is a customized diagram used to identify and classify a company's products (and/or services) and markets, so that a full understanding of the value-streams is established.

Participants first make a list the company's products and the customers that it sells to. Then on a white board they construct the first cut of the PMG network diagram.
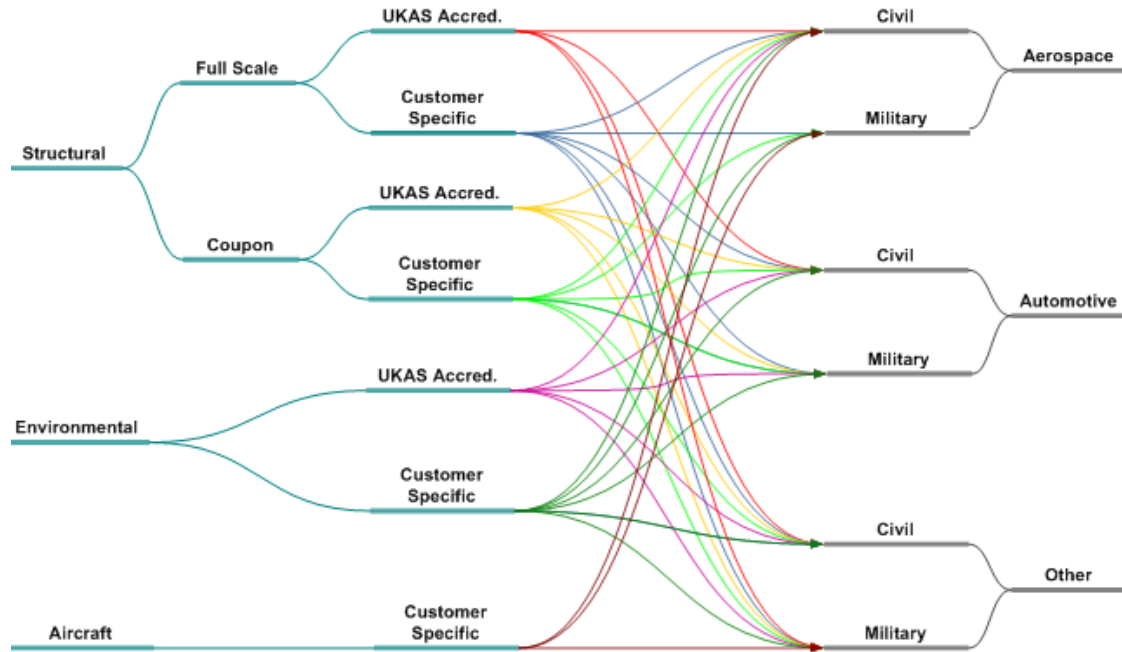
Figure 4: PMG Network Diagram of Manufacturing Service Provider

If the number of nodes and edges are too crowded or there are redundancies, the participants engage in discussions to consolidate products and customers (markets) with a convergent frame of mind using the appropriate criteria to facilitate grouping. Products may be grouped together according to:

- Product attributes: material, specification, configuration, size, shape and degree of customization.
- Process attributes: production, assembly and packaging technologies (e.g. automated vs. manual)
- Value stream attributes: outsourced, factored-in, licensed-out or franchised products or services.

Likewise, customers can be grouped together according to geography, demographics, or customer type (e.g. b2b, distributors, retailers, end users etc). It has to be noted that there can be company specific product and customer attributes other than the ones listed above which provides a more appropriate criteria for grouping. After the consolidation exercise was performed in our case study, the number of PMGs reduced from 35 down to 10.
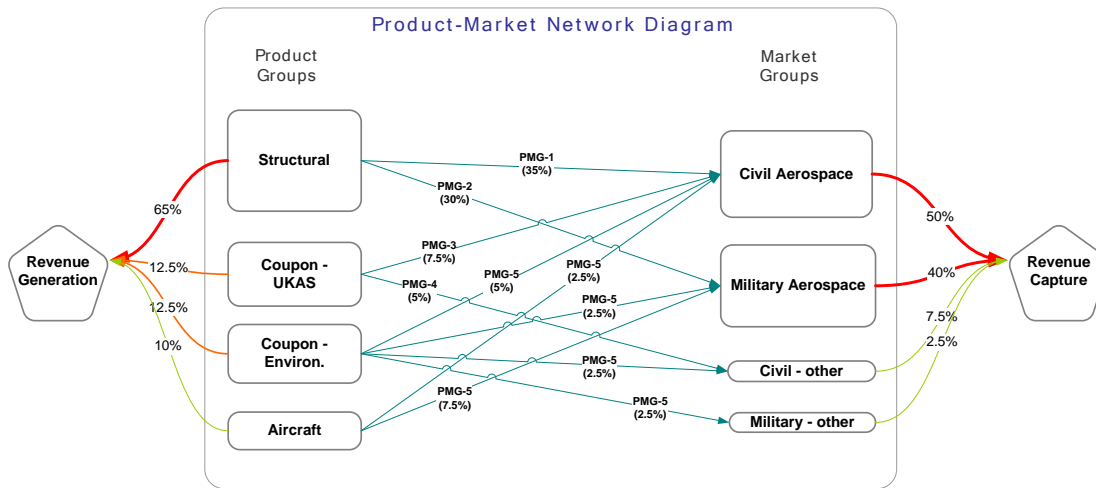
Figure 5: Consolidated PMG Network Diagram

It is also useful to indicate the revenue breakdown per PMG, product group, and market group. The size of the rectangles may be adjusted to indicate the relative size of revenues generated from each product or market group.

The PMG network diagram can also be enriched with the use of different shapes, sizes and colours for different nodes and edges if additional information is to be embedded.

Evaluation

There are a number of cognitive benefits of using a PMG network diagram. First, the revenue breakdown by product-market group rather than only product or market group enables a different perspective on the strategic analysis process. Second, the exercise that managers have to go through in the development of the diagrams stimulates thought as to how products and customers can be segmented most sensibly. A number of strategic options usually emerge during this exercise such as the option to stop selling to an unprofitable customer, or to cross-sell products from other product portfolios to an existing customer. And last but not least, the PMG network diagram is a powerful tool to visualize a comprehensive picture of the company's revenue streams.

There are also some challenges that need to be overcome. The main challenge is experienced when a company has too many different products and customers. The network diagram then becomes too large, overriding its intended cognitive benefits. It nevertheless represents the reality and even a complicated diagram provides valuable insights. One measure to reduce the complexity of the diagram is by grouping products and customers into groups. By

introducing a hierarchy using these groups, the appropriate level of detail can be selected. Software tools with zoom-in/zoom-out and hiding characteristics can be very useful to facilitate this.

Case Learnings

Understanding revenue streams is one of the key steps in strategic analysis. It is easy to lose sight of the core revenue streams in companies where the revenue structure is complicated. A PMG network diagram enhances understanding of the revenue streams and stimulates the development of new strategic options both during its construction and after it is complete. It is particularly useful to go through the development of the diagram in a group setting where representatives from top management and finance are present so that a common understanding and a shared vision can be achieved. Use of software tools with grouping and hiding characteristics may reduce development time and maximise cognitive and communication benefits. It should also be noted that some participants prefer physical media rather than a software tool.

CASE 3:

Development of a Consistent Key Account Strategy through Joint Customer Ratings and Strategies

Strategy phase(s):	Analysis and development
Level:	Company
Primary content:	Facts, experiences, options, actions
Thinking type(s):	Convergent
Main benefits of visualization:	Social: eliciting and aligning ratings of cross-department key accounts
Visualization formats used:	Elaboration technique: parameter ruler

Company Context and Strategic Situation

This reinsurance company is a leading diversified multi-line reinsurer. It is active in over a hundred countries and employs approximately 800 people. Its total revenue is several billion dollars, which derive from both the US and European markets. The company has a diverse client base and is profitable. As part of a strategic initiative, the company decided to invest more resources in the handling of its clients. The combination of business unit knowledge about multi-line clients or key accounts is of great importance for the company's optimal negotiation with such clients (i.e., before renewals). To identify the true potential and importance of a multi-line client, the business units need to develop a common understanding about the client (through knowledge sharing) and they need to agree (efficiently and early) on generally acceptable terms regarding the clients. This process of pre-agreement among the business units had not always worked smoothly in the past. In fact, sub-optimal knowledge sharing and pre-negotiation among business units had already led to the loss of substantial business. A common client strategy was often difficult due to another organizational issue: the flexible part of the reward system (e.g., the financial incentives given to client managers) encouraged the underwriters (who assess the risks to be insured) to concentrate on the profitability of their business lines, whereas account managers mainly cared for their geographical region. As a result, underwriters wanted to underwrite contracts with clients only when a certain profit margin was possible. Account managers by contrast, took a more global vision on the client. As a result,

the communication of knowledge among the involved parties became a key issue. It is described in the next section.

The following (anonymzed) screenshot shows how based on the existing customer data (that the client managers brought to the joint workshop on Excel sheets), information was visually integrated in real time (via a laptop connected to a beamer) and then applied to a common rating of each client through a visual ruler. This joint rating laid the ground for the subsequent client strategy. The documented decision for a strategy was then captured visually through the same ruler application and appended with explanatory comments to capture the rationale of the taken decision (see the subsequent screenshot). In this way, the gathered client managers could not only aggregate client data and assessments (opinions) into common decisions, but also visualize client profiles to represent their understanding and common insight into a customer on a company-wide level.
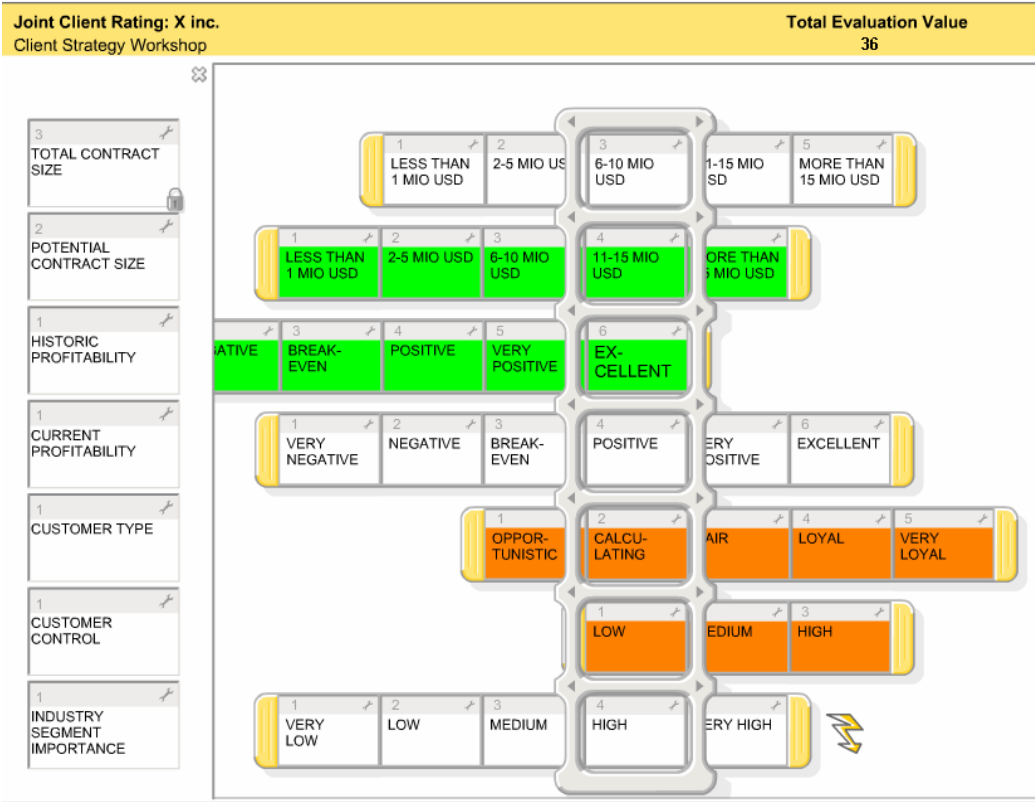

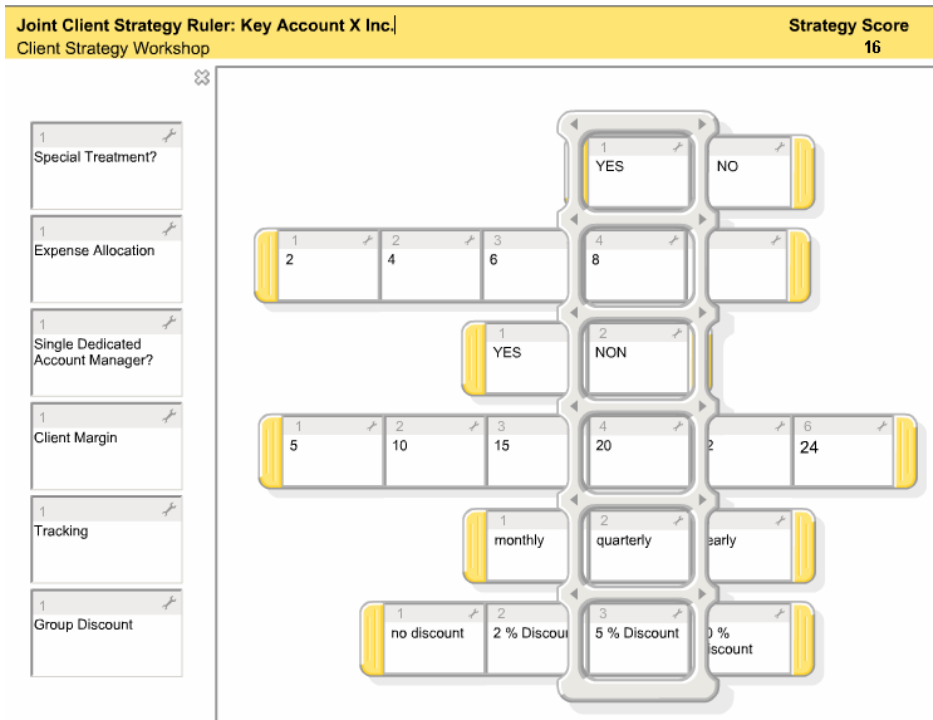**Figure 6: A real-time joint client rating based on the ruler interface**

Figure 7: Example of a jointly devised client strategy

Method Description: Parameter Ruler

The parameter ruler application is split into two sections. The left column designates assessment criteria or strategy dimensions that are rated or completed on the right hand side (the sliders can be moved, edited and annotated as well). The visual metaphor of a slide ruler is employed to help managers establish a common rating schema of an issue, competitor, client, or supplier. To do this the facilitator can ask the group which of the mapped criteria is the most important one and move this criterion up accordingly. He or she can also ask for specific scales for each criterion. These scales are then entered into the empty fields of every slider. Each entry can be further defined and described through the comment box associated with each field (not visible in the screenshots). In this way, a group can have a detailed discussion on each criterion (and its weight), but also see the big picture, i.e., the overall profile of the current rating. If the ruler is used in combination with a Smartboard the horizontal sliders can be moved simply by touching the slider and moving it left or right. In the case of a virtual ruler session via Internet application sharing, the facilitator can allow such movements for any or for only select meeting participants.

Evaluation

The main advantage of the parameter ruler is that it takes people away from their individual data and opinion and focuses them on common ratings and thus a collective perspective and synthesis that allows comparisons among clients in a systematic and joint way. In this manner, it fosters the integration and alignment of knowledge through a jointly devised and adapted artefact – the final ruler profile. A disadvantage of this method is, however, the fact that people who may be shy may not get the chance to voice their opposition and make their arguments known and visible. As in case 1 groupthink should be actively avoided by a facilitator who seeks to involve all participants into the visual strategy dialogue. An alternative way would be to ask for individual ratings that need to be submitted before the collective ratings are developed.

Case Learnings

Interactive, real-time visualization can be used effectively to integrate strategic knowledge, combine diverse perspectives, and use them for strategy development. The visualization tool, however, has to be used by an experienced facilitator who ensures that each participant's knowledge is adequately represented and that the resulting visualization is not a consensus illusion. This can be achieved by capturing the participants' individual ratings upfront.

CASE 4:

Developing a Capacity Strategy for the Packing Plant of a Polymer Manufacturer

Strategy phase: Development

Level: Department

Primary content: Production variables

Thinking types: Divergent - convergent

Main benefits of visualization   Cognitive (variable linkages, cause and effect), social (communication, build-
ing   consensus)

Visualization format used: Elaboration technique: Tool for Action Plan Selection, (TAPS)

### *Company Context and Strategic Situation*

A leading company in the field of innovative thermosetting polymers, with a turnover of £115 million and employing 300 people was forecasting an increase in demand and was looking into ways of increasing its existing capacity. The managers knew that the existing packing plant capacity was under-utilized and they wanted to find a solution to increase capacity utilization. The company used the TAPS tool to help them identify the most appropriate actions, which were then implemented.

Method Description: Tool for Action Plan Selection, (TAPS)

TAPS is a software tool based on the connectance concept, developed by John Burbidge (Burbidge, 1984). It enables users to build a network diagram to represent the inter-relationships between a production variable and its connected variables. In the network diagram the variable is displayed as a node with arrows linking it to other nodes. Arrows connect variables to indicate the existence and direction of a connectance. A customisable database holds information on both the variables and their relationships (the nodes and arrows). Analysis tools enable the users to 'trace-up' or 'trace down' from any variable in the network. This allows the impact of changes in variables to be readily visualized. Interactive graphic features include sketching and node editing functions (size, colour, move, rename etc.) which enable the user to modify the network hierarchy display. For more detail see Tan and Platts (2003).

In use, a multi-functional group of workers created a model of the variables affecting the capacity of the packing plant. Using a video projector attached to a PC, and running the software tool, the participants were able to follow the construction of the cause-effect diagram step-by-step. This was a very interactive process because each participant had their own views of the way in which variables interacted one with another. Careful discussion was required to ensure that only first order connectance (i.e. direct effects) were recorded. The comprehensive editing tools enabled fast modifications to the diagram. The finished diagram is shown below.

Once a consensus was reached, the group went on to identify attributes of the variables and connectances, for example, the strength of the relationships, the time taken for an effect to manifest itself following a change, the cost of making a change etc. This information was recorded and could be displayed as required on the diagram. Using the visualization and the analysis tools the group considered the potential actions that could be taken and their likely impacts. From this they identified short and long term action plans.
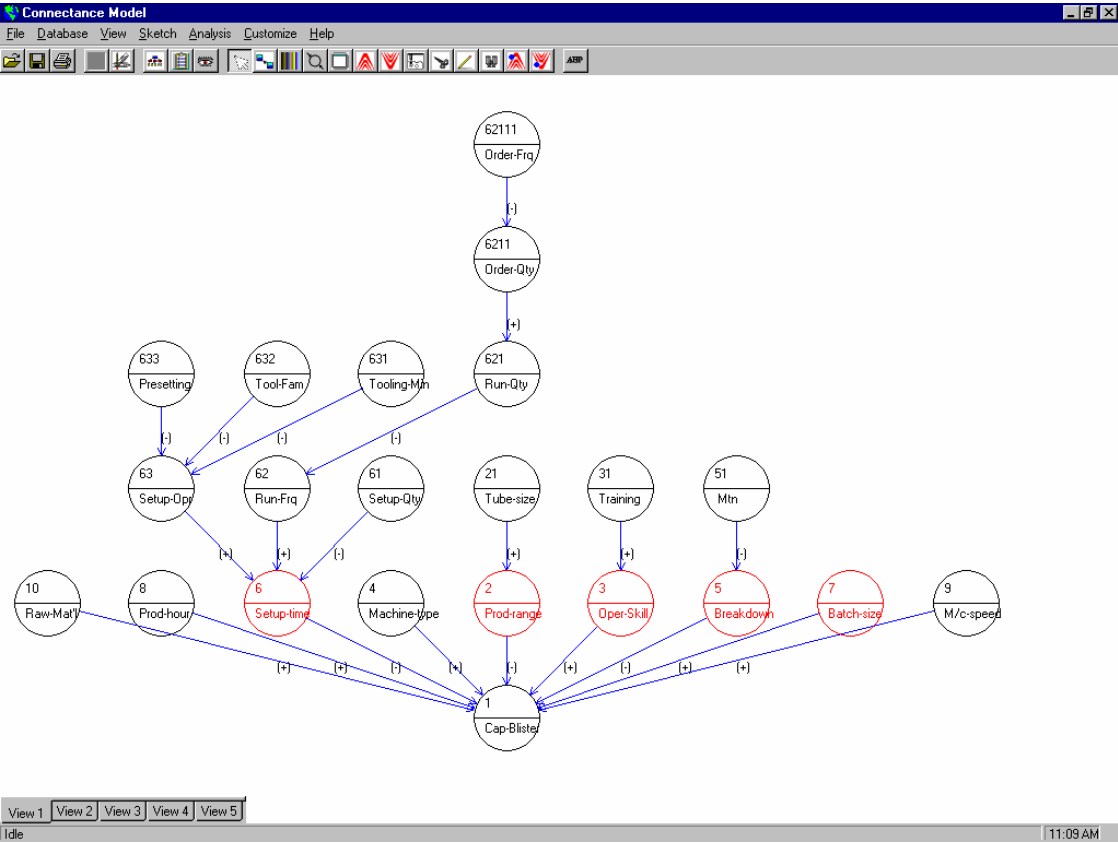
Figure 8: Capacity Variable Connectance Network for Packing Plant

Evaluation

The main advantage of the TAPS visualization tool within the action planning process is that it provides participants with a way of formalizing, capturing, and sharing their mental models. The visualization, facilitated by the software tool, enables a group of managers to share and develop an agreed understanding of the way in which a system operates. The visual network diagram assists them in getting an overall view of the variables involved and their cause-effect relationships. This prompts discussion on three levels: first, defining and understanding individual variables; second, identifying variable linkages; and third, characterizing and evaluating the attributes of the linkages. Using the visualization, managers are able to explain the logic behind a set of improvement actions. The ability of the software to filter, based on variables or linkages, is extremely useful when trying to make sense of, and communicate the behaviour of, very complex systems. Thus the visualization tool imposes structure, providing a clear and systematic approach to analyzing, diagnosing and developing solutions to a particular problem. The database functions of the tool allow users to store visual models for later re-use or adaptation. A further advantage of the visualization is that it allows managers to communicate actions and the rationale behind them to other staff.

In terms of potential disadvantages, there may be initial reluctance to use the software for several reasons. Firstly, there is a learning curve associated with it. Although the software is intuitive and icon driven, it still takes several hours to become an adept user. Secondly, there may be an initial fear of a 'black box' solution. This can be rapidly overcome when it is realized that the software does not do any decision making but instead provides users with a way of manipulating and displaying data that has many advantages over traditional methods of flipcharts, whiteboards etc.

Case Learnings

Communication and subsequent discussion of visual models is greatly enhanced by the ability to manipulate the models in real time. The use of a computer with video projection provides a simple and quick way of achieving this. Such discussions lead to the building of shared consensus models that form the basis for subsequent analysis. However, using custom software for visualization will require a learning curve which may discourage its use. Therefore the software must be intuitive with a user friendly interface. Secondly, visual models are very useful in explaining the logic behind actions in complex environments. Software with filtering capability is particularly valuable in this role. Finally, there are social benefits related to the

use of visualization. The use of a visualization tool allows individuals with differing perspectives, values, and beliefs to make sense of actions that might otherwise appear inappropriate. This builds understanding and improves group cohesion.

Planning and Tracking a Functional Strategy within a Multinational Universal Bank

Strategy phase:	Planning and Implementation
Level:	Department
Primary content:	Yearly goals and actions (incl. synergies and conflicts among goals)
Thinking type(s):	Mostly convergent, some divergent (new synergies)
Main benefits of visualization:	Social (co-ordination) and cognitive (overview and sequence)
Visualization format used:	Sequencing method: Synergy Map

Company Context and Strategic Situation

A key service department in the corporate centre of a large multinational universal bank re-assesses its strategic objectives and their implementation steps on a yearly basis. In order to facilitate this process, the team heads of the department meet annually for a one-day strategy workshop, working with one single visualization method, the synergy map (see the figure below). At the time of this reporting, the synergy map had been used in this manner for five years. During the first three years the method was used in a 'manual' mode, i.e., with post-it notes and a large brown paper. In the two subsequent years the visualization method was used with dedicated software support using a computer and projector. Originally, the synergy map was deployed to foster the knowledge of the different team leaders about their colleagues' goals and plans and how they could be affected by, or contribute to, these goals. Previously, the department struggled with a myriad of initiatives that were often not closely related or aligned. This also led to a lack of cohesion and strategic alignment in the department. Through the synergy map exercise and its periodic (i.e., quarterly) reviewing and updating, this problem was eventually overcome and the department succeeded in focusing on common priorities and keeping its staff informed about the various team activities.
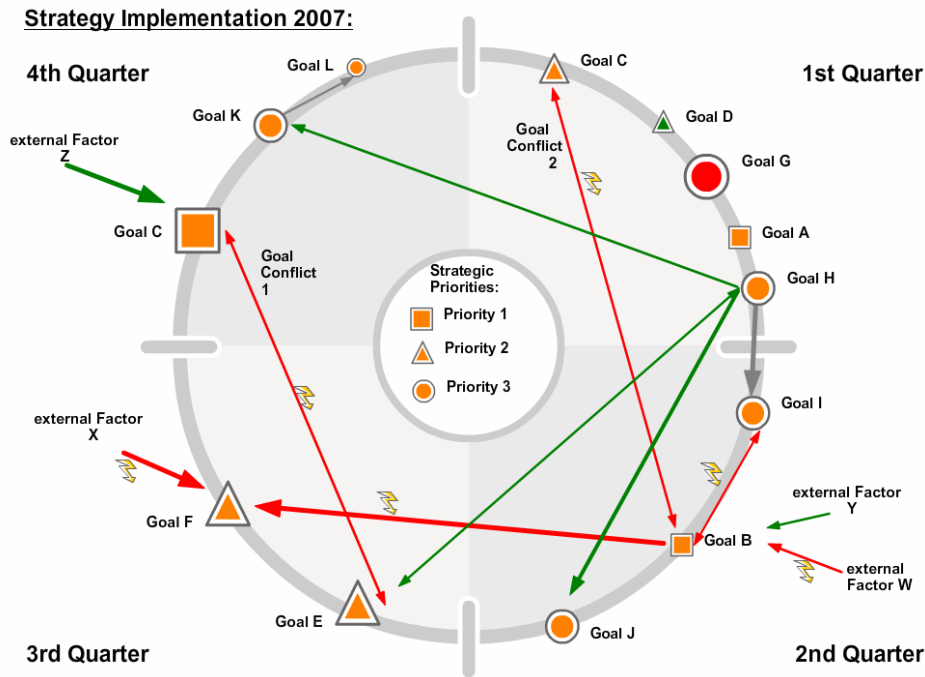
Figure 9: A generic synergy map for strategic actions sequencing

Method Description: Synergy Map

The synergy map facilitates the visual discussion of the main goals and sub-goals necessary to move the implementation of a strategy forward during a year (or alternatively a two or three year period). Based on the key priorities of an organization (placed in the centre of the synergy map) a management team positions (through a brown paper poster and cards or via software and a PC-projector) its main goals along a circular timeline (based on each goal's deadline). The size of the goal icon designates the amount of work (i.e., budget) associated with reaching each sub-goal. The shape of the goal provides the link with the strategic priority supported through the goal (sometimes priority flags are added to the goal icons). The goals are then analyzed in terms of possible mutual goal synergies or conflicts. Each identified goal synergy (i.e., how one goal can help another or how two goals can be used for mutual benefits) and each goal conflict are captured as arrows on the map that connect two goals. They are discussed and annotated with action items or caveats. In addition, key external influences are mapped outside the circle. They indicate positive or negative external influences on the goals to be reached. The colour coding can be used in different ways: it can indicate the current level of goal completion or it can designate goals of different teams in the department.

Evaluation

The main advantage of the synergy map is that it helps management teams to systematically identify interdependencies (synergies and conflicts) among their strategic goals, after having established their sequence. This may not be possible by simply talking through, or thinking about, their goals' relationships. By drawing the multiple goals related to a strategy in a circle, synergistic and conflicting goals can easily be connected, and the nature of the synergy or conflict can be labelled. In addition, external influences can be compiled and mapped and possible responses or preventive measures can be discussed and recorded. The synergy map is also particularly helpful in making a team aware, at the planning stage, of possible implementation bottlenecks. If several large goal icons have been positioned close to each other, this may be an indicator of a future resource problem. Consequently, reserves need to be allocated or goals distributed differently. In the implementation stage, the synergy map can serve as a tracking device to keep the team informed about already accomplished tasks and goals that still need to be achieved. In terms of disadvantages, the synergy map method requires a willingness of a team to experiment with a new format and (if used as a tracking device) a new organizational routine. The synergy map may also reveal conflicts among goals that are hard to resolve and it may thus create (nevertheless fruitful) tension. In certain circumstances, Team members may engage in tactical behaviour and not list all of their goals, as they know their objectives will be visualized, documented, communicated and tracked. In this sense, the visualization may be an inhibiting factor for a free-flowing discussion. In such cases, it may be better to lead the strategy discussion without capturing the elicited goals right away.

Case Learnings

The advantage of a visualization to make a strategic conversation persistent has to be actively exploited by periodically reviewing and updating the strategy visualization and thus using it to keep fellow managers committed to the agreed upon priorities and action steps. Before that, however, the joint completion of the synergy map at least once a year seems a crucial event to develop a strategic 'big picture' that can then inform the strategy implementation process.

CASE 6:

Communicating the Growth Strategy and Key Performance Indicators of a Market Research Company to all Employees

Strategy phase(s):	Strategy implementation
Level:	Corporation
Primary content:	Strategic goals and metrics, as well as activities
Thinking type(s):	Mostly convergent
Main Benefits of visualization:	Emotional and social: motivation and buy-in, as well as identification, coordination and alignment
Visualization format used:	Interaction technique: visual metaphor

Company Context and Strategic Situation

A Swiss market research company with a turnover of approximately 50 Mio Euro and about 300 employees is the clear leader in its national market with the highest market share (approximately 40 percent) in its sector. In order to sustain this leadership position, the company had developed an aggressive growth strategy, based on the Balanced Scorecard model. However, as the executives soon realised, the complex diagrammatic representations of their strategy were difficult to communicate to its staff and its staff was not really aware of the company's strategy and key performance indicators. Hence, the executives decided to develop a more accessible, interactive, engaging, and memorable depiction of their balanced scorecard-based strategy. The CEO wanted to reach all employees and let them explore what the strategy meant to their personal behaviour or, in other words, how they could help in achieving the strategic objectives of the company. For this purpose, an interactive visual flash movie was put on the homepage of the company's intranet. The movie let employees choose different behavioural options (such attending training or not, documenting processes or not, tracking customer complaints or not) and they could immediately track the effect of their simulated action (or lack thereof) in the animated balanced scorecard tree (i.e., low investment into the roots or know-how of the company lead to a weak trunk and ultimately to small financial 'fruits'). This playful and interactive way of communicating the strategy in a simple visual metaphor illustrated its implications for all employees and caught their attention.
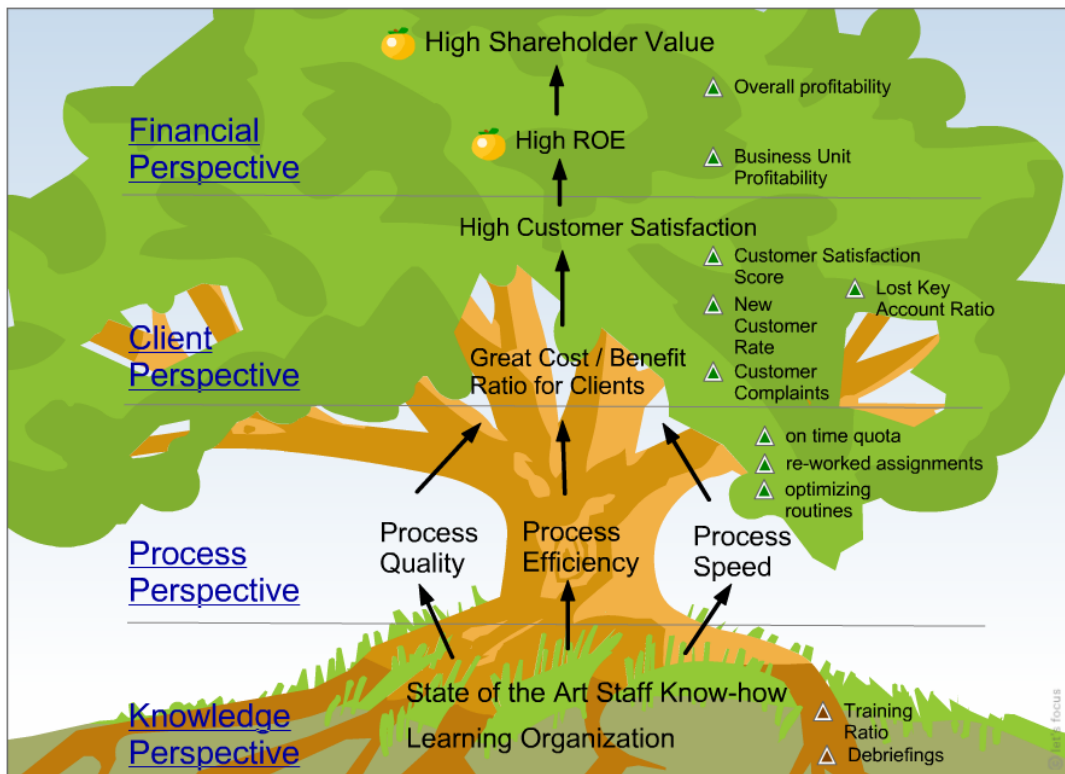
Figure 10: An interactive, intranet-based balanced scorecard tree for strategy communication

Method Description: Interactive Balanced Scorecard Tree

The simple key idea behind the interactive Balanced Scorecard tree is to map the four dimensions of the Strategy Map diagram (Kaplan and Norton, 2000) onto the four elements of a tree, namely its roots, trunk, crown, and fruits in order to emphasise the strategic inter-dependence of the four dimensions of the balanced scorecard (i.e., if the roots are weak, the trunk is not stable, the crown small and the fruits not abundant) and to use the positive connotation with the tree image to create a positive communication context. The interactivity of this visualization can be explored in various ways: When clicking on one of the underlined perspective titles on the right, the key goals and performance indicators are shown and explained by the CEO's recorded voice. There is also an interactive version of the tree where employees see the consequences of their action on the strategy tree. There is an instructive version that helps employees understand the basics of the concept of a balanced scorecard.

Evaluation

The key advantage of this kind of strategy depiction is that it is more accessible, engaging and thus motivating than a complex management diagram like the Balanced Score Card Strategy Map. The management of the company believed that by providing a simple, interactive, visual metaphor employees could grasp the essence of the strategy quicker, retain more of its elements and feel more inclined to reach the articulated goals. The picture provides an easy reference point for subsequent conversations among employees and lends itself to memorable presentations and workshops where it can also be used to track the current status of strategy implementation. However, what also became apparent, in terms of disadvantages, is that the power of a visual metaphor (i.e., its interpretative openness) can also become a potential risk: Some employees began to discuss negative associations with the strategy tree that the management simply did not anticipate (such as: what is the moss on the tree trunk in our company?). In order to be effective in its communication, the visualization also had to be simplified which poses the risk of neglecting important relationships among elements.

Case Learnings

The visualization format that is used to develop a strategy may not work equally well to communicate the same strategy to people not involved in the strategy development process. Hence, a change in the visual format may be necessary to effectively communicate the essence of a strategy internally and / or externally. In addition to supporting thinking and group communication, such a strategy visualization can engage employees and provide motivation and buy-in (if it is adequately presented and explained).

These six cases have illustrated the use of visualization along the strategy process. They have shown how visualization can improve the strategy process in terms of thinking, communicating and engaging others. The cases have also shown, however, that there are several challenges that must be addressed when using visualization in strategizing, especially in the strategy development phase. These challenges and corresponding future research needs are further explored in the conclusion.

Conclusion: Challenges and Research Needs

In this article we have examined the use of interactive (paper-based and computer-supported) visual methods in the strategy process. We have shown when during the strategy process visualizations can be beneficial; we have indicated what types of visualization can be used at each stage and identified the benefits that can result; and we have addressed how visualizations might be used, from both a theoretical and practical perspective. We illustrated the practical aspects by showing how new interactive visualization methods, developed by the authors, were deployed in business strategizing contexts.

Although we have concentrated on the benefits of visual methods for the cognitive, social, and emotional challenges of the strategy process, we should not neglect the drawbacks and potential risks of using visualization in this context (for general visualization drawbacks see Tversky 2005). Visualization, if used ineffectively, may lead to superficial analysis, overgeneralization, and to a mere illusion of deep understanding. It may replace elaborate, text-based, argumentation with often implicit assumptions and inferences (which is a frequent problem in presentation slides), and it may lead to ambiguous communication and misunderstandings if the visualization itself is not well explained, presented and documented. These potential shortcomings indicate the need for strategy visualization guidelines. Although general research-based visualization guidelines have already been developed (see, for example, Jarvenpaa & Dickson 1988) there are more specific challenges that need to be addressed: In the conclusion to this article, we point out five specific challenges that emerged during our case study research in the emerging field of visualizing strategy. We believe they should form an agenda for future research.

Challenge 1 - 'Seeing openly': visualization may alter face-to-face strategic conversations

In the case studies 1, 4 and 5 it became apparent that visualizing the contributions of participants in strategy workshop might affect their contributions in at least three negative ways:

a) Managers may tend to be less forthcoming regarding their contributions if they know that their statements are being captured and documented. They may become overly careful of their contributions, knowing that they are being visualized and possibly stored electronically.

b) Managers may distort their contributions (regarding past mistakes) for political or tactical reasons or in order to save face in front of others.

c) Managers may over-construct their contributions to make them fit a particular visualization schema, i.e., they could try to make sense of their past experience in an inaccurate way (ex-post rationalization to fit the graphic framework).

This challenge can be addressed through proper facilitation that combines individual prompting with collective visualizing. The facilitator should be careful not to rush the capturing of contributions; participants may need time to become comfortable about sharing delicate information. A future research question is thus: In what circumstances might visualization be counterproductive?

Challenge 2 - 'Seeing correctly': assuring consistency and comprehensiveness in the visualized content.

In case studies 1, 2 and 6 it became apparent that visualization may contain a risk of leading to hasty generalizations, insufficient option screening, premature closure or inconsistent compilations of elements. In order to prevent this risk, a facilitator has to force participants to argue their contributions well and justify their choices. He or she may use backup help of analysts that check– in real time, or after a strategy meeting in the case of strategy analysis or development – whether the compiled strategy visualizations are consistent and at the right level of detail. Future research should investigate how far such checks can be (and should be) built into strategy visualization software or methods.

Challenge 3 - 'Seeing clearly': scalability and cluttering a strategy diagram

As they capture more and more strategic content, visualizations may become too complex, or cluttered, to efficiently organize a strategic conversation or communicate a strategy and thus they may lead to confusion instead of clarifying options, preparing decisions or motivating action. This became apparent in case study 2, but also in case studies 5 and 6. As a possible countermeasure, the use of software that allows for filtering, zoom-in/zoom-out, grouping or information hiding may be a feasible solution. Another solution is to simply collapse elements into higher-order groups or categories and thus reduce complexity. Future research should investigate novel means of hiding complexity without distorting strategic content.

Challenge 4 - 'Seeing differences': visualization may de-emphasise or hide individual differences of opinion or assumptions.

Another potential risk, illustrated in case 4, lies in abusing joint visualizations to give a false impression of a consensus. If 'seeing is believing', then seeing one strategic representation on a screen or page may lead a manager to believe that it represents the collective reasoning in a team, when there may still be substantial disagreement. Hence, one should gather individual opinions and assessments and present and compare them before collective visualizations are developed (such as profiling of company's strengths and weaknesses). Future research should consequently investigate how personal and collective visualization can be combined to assure that individual differences in strategic perspectives can be made visible and be taken into account.

Challenge 5 - 'Supporting seeing': choosing the right visualization medium for the right strategic task

Choosing the right mode of visualization (also in terms of the available time and other resources) is clearly a key challenge throughout the strategy process. Both software-based visualization and physical media have disadvantages and advantages for strategizing; how can they be used in a complementary way? When should a team use software like TAPS (case 4), when wallpaper methods like strategy charting (case 1)? When should a strategy be communicated as an interactive visualization on the intranet (case 6), when presented in a slide presentation by the CEO? The number of participants, the strategic phase, and the nature and complexity of the strategic content affect this decision, but their specific role has to be further clarified. A final future research challenge hence lies in matching visualization methods and strategic situations. One way to investigate this issue is through qualitative in-situ experiments (Weick, 1977), where researchers support managers in their strategic deliberations and evaluate the success of their interventions, as we have done in this contribution.

In spite of these challenges our case studies show the great potential of a visual approach to strategizing. In this article, we have advocated a *process view of visualization*, where the graphic rendering of strategy content is seen as a vital sense-making activity, rather than the mere aesthetic rendering of a final outcome. Used in this way, visualization becomes a powerful, analytic business language. Because of new information and communication technology such a new *business language* is emerging – a language that integrates diagrams, text, visual metaphors, and symbols to make better use of strategic content. We have only begun to

systematically analyse this emerging business language and map its potential. As managers appropriate this language for strategic management, there is a great need for research and development, training, and evaluation of these powerful methods so that they can effectively help in meeting the wide range of challenges of the strategy process.

References

Acur, N., Bitici, U. (2003) Managing strategy through business processes, *Journal of Production, Planning & Control*, Vol. 14 No. 4, pp. 309-26.

Bauer, M.I., Johnson-Laird, P.N. (1993) How diagrams can improve reasoning, *Psychological Review*, 4(6): 372-378.

Bechky, B. A. (2003). Sharing meaning across occupational communities: The transformation of understanding on a production floor. *Organization Science*, 14(3): 312-330.

Bertin, J. (1983) *Semiology of Graphics: Diagrams, Networks, Maps*. The University of Wisconsin
Press. English Edition.

Buzan, T. (2003) *The Mind Map Book*: Radiant Thinking, BBC Active.

Burbidge, J.L. (1984) A classification of production system variables. In *IFIP Production Management Systems: Strategies and Tools for Design*, ed. H. Hubner. Elsevier Science Publishers. North Holland

Brown, S.L., Eisenhardt, K.M. (1998) *Competing on the Edge: Strategy as Structured Chaos* Boston: Harvard Business School Press.

Card, K. S., Mackinlay, J. D., and Shneiderman, B. (1999) *Readings in Information Visualization,using vision to think*. San Francisco: Morgan Kaufmann.

Christensen, C.M. (1997) Making Strategy: Learning by Doing. *Harvard Business Review*, 141- 156.

Das, T.K. & Teng, Bing-Sheng (1999) Cognitive Biases and Strategic Decision Processes: An Integrative Perspective. *Journal of Management Studies* 36 (6), 757-778.

David, F. (2005) *Strategic Management - Concepts and cases*, 10th edition, Pearson Education.

DeWit, B., Meyer, R. (2004) *Strategy: Process, Content, Context*, 3rd ed., London: Thomson Learning.

De Bono, E. (1973) *Lateral Thinking. Creativity Step by Step*. New York: Harper Colophon.

Digman, L.A. (1990) *Strategic Management – Concepts, Decisions, Cases*, 2nd Ed., Honweywood: Richard D. Irwin.

DiMicco, J.M., Pandolfo, A. and Bender, W. (2004) Influencing Group Participation with a Shared Display. *ACM Conference on Computer Supported Cooperative Work* (CSCW 2004). Chicago, IL.

Eisenhardt, K.M. (1989) Building Theories from Case Studies, *Academy of Management Review*, 14(4), 532-550.

Eisenhardt, K.M., Kahwajy, J.L., & Bourgeois, L.J. (1997) How management teams can have a good fight. *Harvard Business Review*, July-August 1997: 77-85

Ellis, W.D. (1938) *A Source Book of Gestalt Psychology*, New York: Hartcourt.

Foil, C.M., Huff, A.S. (1992) Maps for managers: Where are we? Where do we go from here, *Journal of Management Studies*, 29(3): 267-85.

Glenberg, A.M., Langston, W.E. (1992) Comprehension of illustrated text: pictures help to build mental models, *Journal of Memory and Language*, 31(2): 129-151.

Godet, M. (1998) Internal motivation and external strategy: The same challenge! , *Long Range Planning*, 31(2): 319-324.

Hitt, M.A., Ireland, R.D., Hoskisson, R.E. (2003) *Strategic Management – Competitiveness and Globalization*, 5th edition, Thomson South Western.

Horn, R. E. (1989) *Mapping Hypertext - Analysis, Linkage, and Display of Knowledge for the Next Generation of On-Line Text and Graphics*, Waltham: The Lexington Institute.

Huff, A. (1990) *Mapping strategic thought*, London: Wiley.

Hull, R., Wu, B. (1997) The definition of a manufacturing strategy analysis/manufacturing system design interface, in: Tan, S.T., Wong, T.N., Gibson, I. (Eds), *Proceedings of International Conference on Manufacturing Automation* (ICMA'97), pp.978-83.

Jarvenpaa, S.L., Dickson, G.W. (1988) Graphics and managerial decision making: research-based guidelines, *Communications of the ACM*, 31(6), 764 – 774.

Johnson, G. Scholes, K. / Whittington, R. (2005) *Exploring Corporate Strategy*, 7th edition, Pearson Education.

Kim, W.C.; Mauborgne, R. Charting Your Company's Future. *Harvard Business Review*, 80 (6): 76-83

Koffka, K. (1935) *Principles of Gestalt Psychology*, London: Lund Humphries.

Larkin, J. H., Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. In
Glasgow, J., Narayahan, H., and Chandrasekaram, B., editors, *Diagrammatic reasoning - cognitive
and computational perspectives*, California: The MIT Press. 1995. Reprinted from Cognitive Science, 11, 65-100, 1987.

Leaderer, A.L., Sethi V. (1996) Key Prescriptions for Strategic Information Systems Planning, in: *Journal of Management Information System*, 13(1), 35-59.

Mandl, H., Levin. J.R. (1989) *Knowledge Acquisition from Text and Pictures*. Amsterdam: Elsevier Science Publishers.

Markides, C.C. (1999) A Dynamic View of Strategy, *Sloan Management Review*, 40(3): 55-63.

Mengis, J., Eppler, M. (2006) Seeing Versus Arguing: The Moderating Role of Collaborative Visualization in Expert-Decision Maker Knowledge Integration, *forthcoming*.

Mills, J. F., A. D. Neely, K.W.Platts, M.J.Gregory. (1998). Manufacturing Strategy - A Pictorial Representation. *International Journal of Operations and Production Management* **18**(11): 1067-1085.

Mintzberg, H., Duru, R., Théorêt, A. (1976) The Structure of „Unstructured" Decision Processes, *Administrative Science Quarterly*, Volume 21, pp. 246-275.

Mintzberg, H. (2005): Strategic Thinking as "Seeing" in Mintzberg, H., Ahlstrand, B. Lampel, J., *Strategy bites back*, 2005 London: Financial Times Prentice Hall

Morgan, G. (1986): *Images of Organisations*, Sage Publications, Beverly Hills, CA.

Norman, D. A. (1993) *Things That Make Us Smart*, Reading: Addison-Wesley Publishing Company.

Nuran, A., Englyst, L. (2006), Assessment of strategy formulation: how to ensure quality in process and outcome, in: International Journal of Operations & Production Management, Vol. 26 No. 1 pp.69-91

Porter (1980): *Competitive strategy: techniques for analyzing industries and competitors*, NY, Free Press.

Porter (1985): *Competitive advantage: creating and sustaining superior performance*, NY, Free Press

Porter, M. (1996): What is Strategy?, *Harvard Business Review*. Nov/Dec: 61-78

Pfeffer, J., Sutton, R.I. (2000) *The knowing-doing gap: How smart companies turn knowledge into action*, Boston: Harvard Business School Press

Platts, KW, Mills, JF, Neely, AD, Gregory, MJ (1996) Evaluating manufacturing strategy formulation processes, *International Journal of Production Economics,* 46-47(1): 233-240.

Prahalad CK, Hamel G. (1990): The Core Competence of the Corporation, *Harvard Business Review* 68 (3): 79-91.

Kaplan R.S., Norton, D.P. (2000): Having trouble with your strategy? Then map it. *Harvard Business Review*. September-October: 167-176.

Roos, J., Bürgi, P. (2003) Images of Strategy, European Management Journal, 21(1), pp. 69-78.

Sparrow, J. (1998) The role of physical representations in knowledge elicitation, in: Sparrow, J. (Ed.) *Knowledge in Organization*s, Thousand Oaks: Sage, 51-78.

Tan, K. H., Platts, K.W. (2003). Linking Objectives to Action Plans: A Decision Support Approach Based on Cause-Effect Linkages. *Decision Sciences Journal* **34**(3): 569-593.

Tversky, B. (2005) Visuospatial Reasoning, in: Holyoak, K., Morrison, R.G. (Eds.) The Cambridge Handbook of Thinking and Reasoning: 209-240.

Rhodes, J. (1994) *Conceptual Toolmaking, Expert Systems of the Mind*, Oxford: Blackwell Publishers.

Roos, J. Bart V., Statler, M. (2004) Playing Seriously with Strategy. *LRP* 37, 549- 568

Sabherwal, R., King, W. (1995) An empirical taxonomy of the decision-making processes concerning strategicapplications of information systems. *Journal of Management Information Systems* 11(1): 177–214.

Tufte, E. R. (1983). *The Visual Display of Quantitative Information*. Chesire: Graphics Press.

Tufte, E. R. (1990). *Envisioning Information*. Chesire: Graphics Press.

Vessey, I. (1991) Cognitive fit: A theory-based analysis of the graphs versus tables literature. *Decision Sciences*, 22: 219-241.

Weick, K. E. (1977). Laboratory experimentation with organizations: A reappraisal. *Academy of Management Review, 2*, 123-127.

Zigurs, I. Leadership in Virtual Teams: Oxymoron or Opportunity? *Organizational Dynamics* Volume 31, Issue 4 , January 2003: 339-351.

Zwicky, F. (1969) *Discovery, invention, research - through the morphological approach*. Toronto, The Macmillan Company.