Decision Making in High Velocity Environments: The Importance of Guiding Principles

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Abstract

This paper presents a field study of decision-making processes at two organizations operating in high velocity environments. It reviews existing literature on managerial knowledge structures and decision-making, and identifies methodological and conceptual limitations with these approaches with respect to organizations in high velocity environments. The authors develop two interpretive cases that focus on the articulated and social methods management teams used to make decisions. They found that both organizations used rules of thumb or heuristic reasoning in their decision-making, that these rules of thumb functioned as headlines of deeper organizational narratives, and that these narratives were grounded in emotional as well as purely rational considerations. We suggest that the term “guiding principle” usefully integrates our three findings into a second-order concept that may be further explored in future research of both a descriptive and prescriptive nature.

Descriptors

Decision-making, high-velocity, heuristics, narrative, emotion, guiding principles

Introduction

High velocity business environments are characterized by rapid and discontinuous change in demand, competitors, technology, and/or regulation. Management teams operating in such volatile contexts must make decisions against a background of ambiguous information, high-speed change, and lack of ability to verify all facts (Bourgeois and Eisenhardt 1988). While some studies suggest that management teams in such environments should conduct formal meetings and consider extensive evidence (Eisenhardt, 1999), others point out that too much information search can cause valuable opportunities to be lost (Klein 1998). Management teams thus face conflicting demands to make decisions rapidly while evaluating extensive (questionable) information, which led us to focus on the role that cognitive short cuts might play in guiding decision makers in high velocity environments.

Cognitive frameworks for decision-making have been a focus of study in the management field for many years (e.g. Lyles and Schwenk 1992). The broad label for such frameworks is "knowledge structures" –mental templates or cognitive filters imposed by individuals on an information environment to give it form and meaning (Walsh 1995: 281). While the extensive literature on knowledge structures provides many theoretical insights and presents results of studies conducted under controlled environments, fewer studies focus on their role in making sense of issue streams leading to decisions in real organizations. In this paper, we investigate how actual management teams operating in high velocity environments—with limited time to gather and cognitively process all relevant alternatives—make decisions. The purpose of this paper is to build theory related to decision-making in high velocity environments, using interpretive methods to study contextualized processes *in the field.* Based on the two interpretive case studies, we develop three interlinked, first order findings that describe key elements of the way in which two management teams made decisions. We use these three findings to develop the second order finding of *guiding principles,* which help shed light on decision making processes in high velocity environments.

Knowledge Structures and Decision-Making

Cognitive scientists have long suggested that individuals and collectives such as groups in organizations are influenced by a number of "top-down", theory-driven cognitive mechanisms when they make decisions. "Knowledge structures" draw on a rich store of general knowledge of objects, people, events and their characteristic relationships (Nisbett and Ross 1980), and have a major impact on decisions separate from "bottom-up", data-driven factors more commonly evaluated in decision processes.

Knowledge structures can take many forms. Originating within the domain of neurobiology, the notion of cognitive *schemata* has contributed to the development of the cognitive school of psychology, which subsequently inspired the extensive literature on managerial cognition. Schemata are cognitive structures that represent one's general knowledge about a given concept or stimulus domain, including its attributes and the relations among those attributes (Fiske and Taylor 1991). *Causal schemata* provide general conceptions of how certain kinds of causes can produce certain kinds of effects while *scripts* provide a coherent sequence of events expected by the individual (Abelson 1976). The study of schemata may be particularly relevant in high velocity environments, as individuals rely more on schemata than on additional data gathering as time pressures increase (Fiske and Taylor 1991). On a social level, individual cognitive schemata can combine to form an overall *interpretive scheme* mapping relevant aspects of how an organization's experience of its world is to be understood (Ranson et al. 1980), and embedding fundamental assumptions about why events happen as they do and how people are to act (Bartunek 1984). Interpretive schemes may build on "shared mental models" or organized bodies of knowledge that team members have in common (Kim 1997).

It has also been proposed that decision-making is influenced by one's *values*, which serve as standards guiding the conduct of individuals in a variety of ways (Harrison 1987). At the level of the group, values have to be reconciled with group *norms*, which regulate the standards of conduct among the members of a collective in the form of regular behaviour patterns that are

relatively stable (Bettenhausen and Murnighan 1985). *Frames of reference* include fundamental epistemic, ontological and ideological assumptions upon which organizational activity and inquiry is conducted that constrain organizational actions (Shrivastava et al. 1987). Organized social systems such as firms respond to change through constructing, developing and transmitting *routines*, which constitute the memory and specific operational knowledge, store and facilitate the diffusion of information and help co-ordinate actions (Nelson and Winter 1982).

Limitations of Knowledge Structures in Understanding Decision Making

Most studies into the role of knowledge structures for organizational decision-making rely on some key, limiting assumptions. The first is the recurrent notion that decisions themselves are moments in time in which a course of action is selected (e.g. Harrison, 1987). This view has been challenged by Simon (1965), who asserts that decision making is not a unitary event, but a complex social *process* involving the directing of attention, discovery, designing courses of action, evaluating alternatives, and choosing among them. Langley et al. (1995) suggest that the construct of "the decision" itself reinforces the notion that organizations are mechanistic and bureaucratic entities, in which any individual in the same task environment would make the same decision. Decisions in real organizations are not faced in isolation, but interlinked with other decisions into "issue streams" that evolve dynamically over time (Langley et al. 1995: 274).

Second, since the Enlightenment, the idealized form of decision-making has rested on key assumptions of *rationality*, or consistent, value-maximizing choice within specified constraints (Allison 1971). In practice, however, people "satisfice" or seek solutions they consider good enough in a given situation, making decisions that are—at best— based on bounded rationality (Simon 1957). This idealized notion of pure rationality has been called an unnecessary and "mystifying" limitation that obscures important aspects of organizing (Shrivastava et al. 1987: 90). Decision makers should not be considered to be machine-like

entities to which problems, opportunities, and choices happen; they decide based on inspiration, affect and insight, “listening to the voice emanating from his own subconscious or…his own imagination” (Langley et al. 1995: 268).

Third, decision-making is frequently assumed to be a context-independent activity. Decision makers also operate, however, within organization-wide, deeply rooted shared convictions—cultures or ideologies—that influence a wide variety of organizational activities and so link issues (Langley et al. 1995). One of the benefits of decision-making in a social context is the heightened ability to draw on the experience of all the team members to create new and unexpected solutions, options, and interpretations that are beyond the capabilities of any of the individuals (Klein 1998: 245). Drawing on Habermas, Shrivastava et al. (1987) propose the criterion of “social rationality”, a form of metarationality that takes into account the degree to which a decision is grounded in free discussions and the consideration of human needs.

Finally, with some notable exceptions, most of the research into knowledge structures and decision-making has been conducted in contexts that are relatively simple and controlled. Much work has involved the study of individuals in laboratory, rather than naturalistic settings in which other demands are placed on them (Fiske and Taylor 1991). The limited field studies that have been completed have sought relationships between particular decision making processes and “firm performance” (Eisenhardt 1989a), “effectiveness” (Dean and Sharfman 1996), or “success” (Miller 1997). Leaving aside the critique that such criteria are somewhat arbitrary—others such as “quality”, “acceptance”, and “originality” have been also been proposed (Harrison 1987)—quantifying any of these performance measures is highly challenging. While Klein (1998) avoids measuring performance directly, his field studies have focused on fire fighters, military personnel, and medical professionals—rather than organizational management teams. In sum, much of the extensive research on knowledge structures rests on assumptions that limit its ability to improve our understanding of decision-making processes by management teams operating in high velocity environments.

Method: Interpretive Case Studies

This paper addresses some of these lacunae in the decision-making literature through a descriptive field study of issue-stream based decision-making processes undertaken by management teams in two organizations, studied *in their contexts*. It responds to call for more *in vivo* fieldwork rather than *in vitro* study of decision processes (Shrivastava et al. 1987; Langley et al. 1995), adopts a longitudinal perspective that follows processes in real time as well as retrospectively, and focuses on people and personalities rather than just events. Our research approach resembles the study of "naturalistic decision making" (Klein 1998), although we focus on organizations in high-velocity environments rather than life-and-death decision-making contexts.

We developed interpretive case studies of two organizations operating in high velocity environments, and focused on how these management teams made decisions over extended periods of time. Interpretive studies can usefully clarify the contingent manner in which a particular mix of causal powers has been activated in a given context (Tsoukas 1989), see new theoretical relationships (Dyer and Wilkens 1991), and uncover basic assumptions (Schneider and Shrivastava 1988). Unlike Bourgeois and Eisenhardt's (1988) studies of firms in high velocity *industries*, the two organizations we examined can more accurately be thought of as operating in high velocity *environments*, as neither operated in a clearly defined industry. These environments were characterized by rapid and discontinuous change in demand, competitors, technology and/or regulation, and in which information was often inaccurate, unavailable or obsolete (Bourgeois and Eisenhardt, 1988), making the reliability of information essential for decision-making processes problematic.

Data Collection

The first case site was the development team of LEGO Mindstorms[i], an autonomous, strategic project unit launched by the LEGO company to develop a new business opportunity

on the boundary of the toy, Internet, and computer industries. We studied the team for a period of 22 months from May 1997 and February 1999, from shortly after the team's establishment until the aftermath of the highly successful launch of the new product. Both primary and secondary data were collected during the study period. The first source of primary data consisted of a total of 27 in-depth interviews conducted in five rounds with members of both the Mindstorms team and individuals in the parent LEGO organization. The interviews followed a prearranged set of headings and prompts, but otherwise structure was kept to a minimum, and we probed areas of interest when they arose in the course of the interview. The informants included nine members of the Mindstorms team and five members of the LEGO organization who had close links with the Mindstorms development process. A second source of primary data was observation field notes generated during discussions between sub-groups of the Mindstorms team and the co-authors. The primary data was complemented by secondary data, which included memos, press releases, drafts of organization charts, internal documents, and other reified organizational artefacts generated by team members during the period of study.

The second case study was AI Inc.[ii], a New York-based company formed to build a new artificial intelligence (AI) paradigm—the world's first thinking machine—while financing its operations through the sale of AI applications for business. Four additional researchers joined the two co-authors in studying this organization for a period of 25 months from March 1999 to April 2001. Data collection commenced as the start-up company began hiring external "professional" managers, documented its rapid growth to 130 employees, and continued through to its eventual bankruptcy. The primary data on AI Inc consisted of 11 in-depth interviews with members of the organization, which followed a prearranged set of headings but allowed for probing of potentially interesting subject matter. The informants included all five members of the executive team, as well as four other organizational members. All of the interviews were conducted in the company's offices in downtown Manhattan, enabling the researchers to observe and collect first-hand data on the company's working style. Our secondary data on AI Inc. included e-mail data, internal memos, accounts prepared by team members for public consumption, drafts of strategic plans, and other internal and external

documents. In addition, we analysed transcripts of presentations and question-and-answer sessions conducted by members of the leadership team of AI Inc at a conference in March 1999, where the company's activities were first brought to our attention as researchers.

Data Analysis

To better understand the complex relationships that existed within the data, we proceeded with a multi-step process of data collection and analysis. First, we tape-recorded the interviews and transcribed the interview tapes. Second, we read and re-read the interview transcripts, notes and secondary documents, and identified a number of key decisions faced by each team. Although many scholars propose that individuals draw on cognitive schema and other knowledge structures in order to make rapid decisions (e.g. Fiske and Taylor 1991), it is difficult to observe schemata or other knowledge structures directly *in vivo.* Thus, our third step was to focus on *articulated* (verbally or in written form) and *social* (expressed by more than one individual) techniques that these management teams used to make sense of groups of decision-related issues. Based on the articulated and social elements of each team's decision-making process, we then began generating preliminary categories (Dey, 1993), to which we assigned textual "databits". The data collection and analysis proceeded in an iterative fashion; that is, insights that emerged from early data collection informed the next round of data collection, which led to the refinement of questions, the collection of more data, more insights, and so on. Thus, data collection and data analysis overlapped, while the resulting findings were compared to existing literature, with the aim of raising the work's theoretical level (Eisenhardt 1989b).

The categories that emerged from the data included three interrelated approaches to decision-making observed in both organizations, and constituted our main research findings, each of which was supported by instances of verbatim evidence obtained from organizational members. It should be noted that given the vicissitudes of organizational life, and our view of decision-making as a context-dependent process rather than an event occurring at an isolated moment in time (Simon, 1965), our data does not always consist of well-structured

verbal utterances articulated at precise decision "moments". Rather, it is grounded in our interpretations of articulated and social sense-making processes that ultimately led to the decisions made in each case under study.

Because our research approach was interpretive, traditional notions of internal validity, construct validity, reliability and replicability, and external validity (Yin 1994) are problematic. Reliability and replicability in particular require the existence of invariant laws over time (Numagami 1998). In their place, a number of other criteria have been proposed with which to evaluate interpretive research in the social sciences. Notably, Lincoln and Guba (1985) propose that interpretative research should be *credible*, *transferable*, *dependable* and *confirmable*. We sought to improve the credibility of our research by studying each organization for a considerable length of time (22 and 25 months), and collecting data from many informants (14 and 9), representing different hierarchical levels in each organization. In several instances, we conducted "member checks" (Lincoln and Guba, 1985: 314) of our data by producing summaries of key details/milestones and preliminary categorizations, and checking the accuracy of this information with informants. To improve our study's transferability, we included detailed descriptions of the context of each of the case studies to assist readers in identifying potential commonalities with other organizations. To increase dependability, the study's findings were refined through discussions between the co-authors—and with four other independent researchers in one of the cases—while each research finding was supported using citations from informants themselves. To improve confirmability, we provided a list of the steps we followed—a form of "audit trail"—in collecting and processing the data. We now turn to a presentation of our two case studies, which will be followed by an outline of our findings.

Case Study 1: LEGO Mindstorms

In 2001, LEGO was the largest toy company in Europe, and the fourth largest in the world. From its founding in 1932 in the village of Billund, Denmark, LEGO has become one of the

best-known brands on the planet, with 64% of US households and 74% of European households owning LEGO toys. Although the company grew steadily throughout the 1980s and early 1990s, in the late 1990s sales slowed as LEGO faced new competitors and competitive offerings stemming from the rapid spread of the Internet and technology-oriented toys. LEGO management found it difficult to encourage the development of radically different products to meet these challenges.

In April 1996, team leader Sam Sinclair and LEGO product manager Frank Fulton began work to develop and bring to market a new product called “LEGO Mindstorms”: a programmable brick that could be used with other LEGO pieces to build robots that could perform a variety of challenges, with users connected in an Internet-enabled “global community”. The Mindstorms team was established as an autonomous project unit, reporting directly to the senior management of LEGO. From the beginning, the team set out to operate quite differently from its parent company, using highly unconventional procedures and claiming to disregard hierarchy. “We threw away most of the rulebook, and operated like a small, entrepreneurial business,” said Fulton, distinguishing the team from its parent company.

Over a two-year period, the team grew from its original two members to include 15 individuals representing a variety of nationalities, organizational departments, and industry backgrounds. Team members were located in the US, Denmark, and UK, with many coming from outside LEGO as internal hiring proved difficult. “Many people,” Sinclair recalled, “didn’t want to be too closely associated with Mindstorms…they wanted to maintain some distance in case it failed.” The team made up for its small size by creating an extensive network of external alliance partners, many of whom had never previously dealt with the LEGO organization, including a computer manufacturer, a publisher, a research institute, an advertising agency, a public relations firm, a museum, and a market research company. The Mindstorms team was convinced that a strong network of partners would enable it to take on larger scale tasks than could be accomplished alone, while staying “lean”. The Mindstorms team also set out to work with its partners in an entirely different way than was usual in the LEGO organization. While

the parent company maintained complete control of its rare external partnerships, the Mindstorms team specified that it wanted to work with its partners on an *equal* basis.

Operationally, the team explicitly set out to avoid the step-by-step, “follow the game plan” approach to operating of its parent company, in favour of working on several tasks at the same time to better reflect the constantly changing business environment it was facing. The Mindstorms team would largely forgo traditional toy retailers and focus on unfamiliar channels such as consumer electronics stores and educational learning stores, which meant it faced new competitors such Microsoft, Sony, Nintendo, and Sega.

A common subject of debate was how Mindstorms should be connected to the LEGO company. In August 1997, after spending a great deal of time and effort building contacts with LEGO managers, Sinclair designed a highly elaborate organization chart showing how his team “fit in” with the rest of the organization. However, the boxes and arrows of an organization chart seemed inadequate to describe the fundamental differences between the orderly core business that was servicing an existing market on the one hand, and the newer more chaotic team trying to create a new market on the other. Sinclair began adopting a more metaphorical way of describing the linkage, referring to Mindstorms as a “satellite” orbiting around the core business. He emphasized that it was important for all new business development ventures to “stay in orbit”, not drifting too far away into oblivion, nor getting too close and burning up.

In January 1998, LEGO Mindstorms conducted its global public relations launch. The event was covered by one-half of all US television stations, as well as CNN and the BBC, and was estimated to have reached more than one billion people around the globe. In September 1998 the product went on sale in the United States and the UK, and sales were double the projections—stores were sold-out by Christmas.

Case Study 2: AI Inc.

Originating with the collaboration between artificial intelligence (AI) scientist Bob Goodwin and Wall Street economist Laura Pierce, “AI Inc.” was established in 1997 to build “the world’s first thinking machine”. Although AI had attracted much interest and investment in the 1980’s, its inability to deliver on initial high expectations led it to be largely ignored by the investment community. Goodwin, however, had developed what he claimed to be a radically different approach to AI based on an evolving series of “nodes” and “links” representing concepts, which he believed emulated the processes of the human mind. Its “natural language capabilities” would allow this new AI system—called “Wow”—to understand what information *meant* in the context of users and enterprises. In theory, it could thus tap into the estimated 90% of the world’s stored business information residing in text documents such as e-mails that previously could only be analysed as fast as it could be read.

Goodwin began by focusing on developing the Wow architecture, which he anticipated could be completed within just a couple of years. However, he and Pierce soon realized that in order to finance this long term development, they would have to spin off some applications or AI “components” along the way, such as: 1) an intelligent web search engine that would conduct meaning—instead of keyword—searches, or 2) a system that would make market trading recommendations by looking for patterns and clues in financial market data on the Web. In 1998, Pierce formulated a strategic plan to develop the market prediction application of Wow and sell it to customers in the financial industry, where immediate profits were expected to be highest.

This plan helped attract the interest of Arthur Smith, the former Head of Fixed Income and Treasuries at a major European bank, who would go on to take over from Pierce as AI Inc’s CEO in March 1999. Smith believed AI Inc. should move rapidly into the Internet space, and began exploring possibilities of getting co-development funding with clients who could then use the technology in specific industry domains. However, the company had trouble “closing

the gap of credibility" with potential partners, so he developed "valuation events" at which application demos were shown to potential investors. The need to develop such demos meant occasionally diverting Goodwin and the development team away from developing the core technology towards developing component applications.

Despite receiving two rounds of financing in 1998, the company almost ran out of money later that same year due to a market downturn, prompting the company to renew its focus on developing marketable applications in 1999. The huge market valuations placed on similar companies at the time enabled the firm to generate additional financing and hire new employees, many of whom were located overseas and who worked with AI Inc. over the Internet in a "distributed" organization structure. This organizational structure made arranging meetings difficult—the office manager recalled: "scheduling four people for a meeting can be a half-day job".

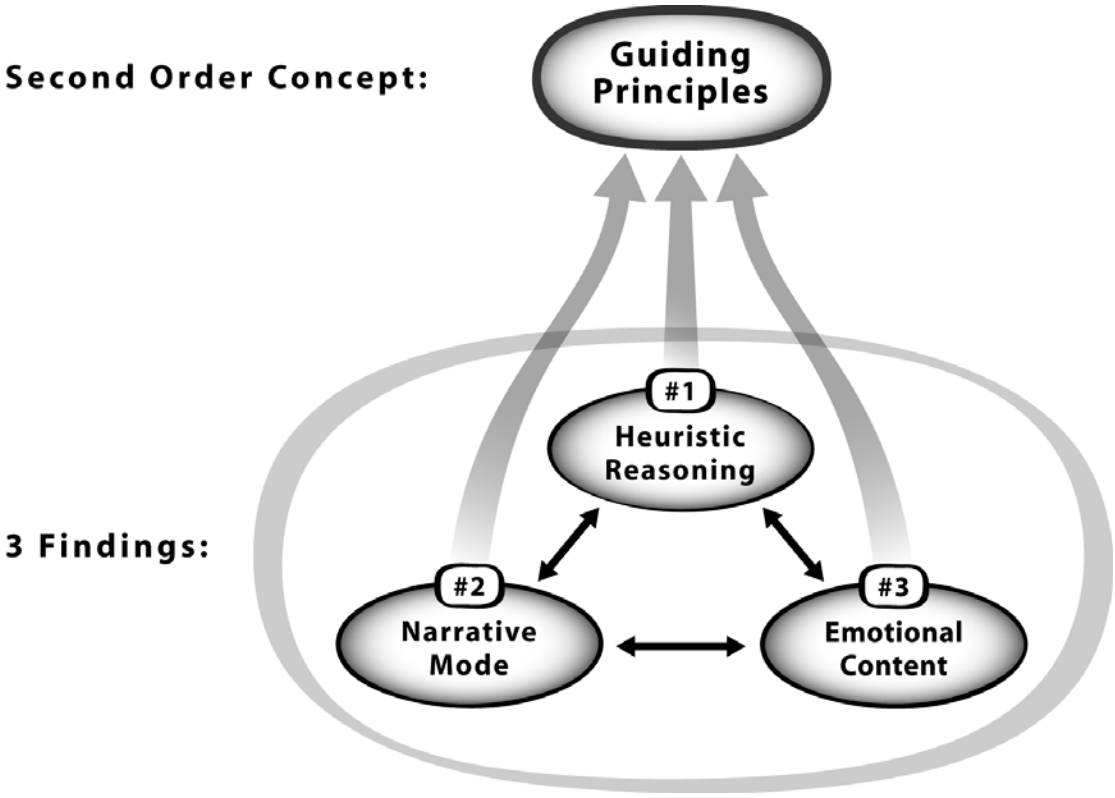
Both Pierce and Goodwin had a fast-paced, "ready, shoot, aim" approach to making decisions which became problematic as the business grew more complex. Their opinions often contrasted with those of some of the newer, more "professional" managers such as Smith, who saw more value in developing plans. For example, the new managers believed the company needed more money in order to develop applications for Wow, while the founders generally wanted to avoid raising too much money from venture capitalists, as this would dilute the founders' share.

In early 2000, the company hired a consulting company to generate a new strategic plan they believed would allow it to continue with its research while giving up the minimal amount of control by selling products to finance its continued operations. However, the bursting of the dot.com bubble dealt AI Inc. a fatal blow. The company's partially developed strategy meant that by the time it was almost ready to sell a particular component such as intelligent web search, most of the Internet companies who would have been potential buyers had gone bankrupt. When a deal with a major media company fell through, AI Inc. began round after round of painful layoffs and ultimately declared bankruptcy in April 2001.

Findings

Our study of the decision-making processes that occurred in each of these two organizations led us to develop three main findings: 1) each organization used heuristic reasoning in making decisions; 2) this heuristic reasoning drew upon organizatnal narratives; and 3) these narratives brought into play deeper emotional content. In the next section we describe each of these three findings in turn, followed by our suggestion for a second order finding—guiding principles—which builds upon the three first order findings (*see Figure 1*).

Figure 1: Theoretical Underpinnings of Guiding Principles



Finding 1: LEGO Mindstorms and AI Inc. used Heuristic Reasoning When Making Decisions

In studying the decision-making processes of the LEGO Mindstorms and AI Inc management teams, we observed that both teams appeared to make frequent use of rules of thumb when making and subsequently justifying their decisions in their respective high velocity environments. Although individual schemata may have influenced the development of these rules of thumb, each one was shared broadly and frequently articulated by many individuals in each group. Unlike behaviour norms or frames of reference, these rules of thumb did not resemble mental templates used to order the teams' environments in the manner of knowledge structures. Instead, they provided explicit, probabilistic decision-making guidance, thus more closely resembling an approach grounded in *heuristic* reasoning.

Heuristic Reasoning in LEGO Mindstorms

We observed several different examples of heuristic reasoning in the LEGO Mindstorms data, each of which was frequently articulated and used by members of the team:

"Stay in orbit": Drawing on the metaphor of a satellite orbiting a planet, this phrase provided a means for the team (and the parent LEGO company) to make sense of the relationship between the two entities—linked by an invisible yet powerful gravitational force. It was invoked numerous times, including during the team's effort to develop a common public relations (PR) campaign with the parent company while maintaining its own identity, as Fulton explained:

> The PR communication is to say that this is something new for the whole corporation…but the danger of such a thing is that the existing paradigm is so strong compared to us so we have to stay out in orbit.

"Stay in orbit" was explicitly used to justify the Mindstorms team's decision to form an alliance with a company who was an archival to an alliance partner to other parts of the LEGO organization. Ultimately, Sinclair believed these incidents would lead to a modification of

LEGO operating procedures. Drawing the satellite model, he commented: "it might be that this satellite over here becomes bigger, with more gravity…so it may end up moving this (the core business) at least a little bit."

"Parallel process": Unlike the core LEGO organization, the Mindstorms team set out to run processes in parallel—and across boundaries—instead of sequentially, and allowed more "chaos" than was permitted in the core business. The launch strategy included a highly compressed development process in which new concepts, channels, media, hardware and software, were developed at the same time. The phrase "parallel process" was used to justify the team's decision to develop the hardware and software for Mindstorms simultaneously; a style of working that had never previously been tried in the parent company. One of the team's engineers explained how this approach increased the team's speed:

> Because most of the development progress was done in parallel, we haven't had to wait for each other to finish things before we could continue with others. Mindstorms progresses on different development tasks at the same time.

Although "parallel process" emerged through scheduling discussions among some Mindstorms engineers, it was subsequently adopted by Sinclair and adopted throughout the rest of the team's activities. Parallel process infused the fast-moving team with an enthusiastic "can-do" attitude, but the fast pace of the team sometimes took a toll on its members. Recalled one team member: "I've never in my whole life experienced so many unknowns, new managers, new organization, new methods, and new people".

"Be a real partner": The team set out to treat its alliance partners—many of which were far larger than Mindstorms—as equals, attempting to work with them collaboratively rather than through a relationship of domination. This principle led the team to develop a range of partnerships with a variety of both large and fledgling organizations, but brought with it some new decision-making challenges. One initiative involved setting up learning centres in which Mindstorms could be profiled to potential users. The team coordinated the initiative in equal partnership with a children's learning organization that supplied the facilities, while the

Mindstorms team supplied the product. Neither partner controlled the venture. One senior LEGO manager initially had difficulty adjusting to this new way of working. Recalled Fulton:

> (She) kept asking me “why can’t you just tell them: ‘this is the way you have to do it’.” But we would destroy the whole thing if we tried to control it… It is not like we can just say, "This is the way it is going to work, this is the way to do it"... they (the children’s learning organization) would just say, “stop”.

This principle also guided the team’s *choice* of partners, as it led the team to avoid partners who were overly dominant. Remarked Sinclair. “I don’t ever see us networking with (an IT firm) somehow. They try to control everything”. Mindstorms team members expressed hope that their partners should feel a sense of ownership for joint projects, and become part of a community of users that would generate new product ideas as well as increased sales.

Heuristic Reasoning in AI Inc.

The AI Inc. management team based many of its important decisions on the following rules of thumb:

Hire based on intelligence. Rather than basing their hiring decisions on how well the candidate would fit into the existing organization, Pierce and Goodwin sought to attract “raw talent”—fascinating, brilliant, independent minds to work on Wow. When making hiring decisions, Goodwin explained that he would: "look for the most brilliant people with the most ideas of their own which relate to what I do”. Pierce described their hiring process as “taking inexperienced people we thought were really smart and hire them in for nothing.” As the company grew from five founders to reach 130 employees at its peak in 2000, the recruiting style of the organization changed. The two founders realized over time that they needed individuals who, while less brilliant, had more specific experience. As Pierce put it: “everyone doesn’t have to be like me.” As the company began facing hard times, Pierce began to question this heuristic to encourage the hiring of more experienced individuals, but by this time it was too late.

Avoid dilution. From the beginning, the founders of AI Inc. wanted to avoid giving up control of the company (dilution). The IT Director explained: "I think we're pretty good at not taking on more venture capital to reduce our dilution." The founders made clear at several points in our interviews that many potentially beneficial alliances were being refused based on this heuristic. According to Goodwin: "one possible business model is to get huge amounts of money from some rich investor, finish building Wow, and then figure out what to do with it. We chose not to do that, because we didn't want to suffer the dilution that that would entail". The question of when to raise money was informed by this rule of thumb. Goodwin remarked: "We never had a lot of extra money in the bank, but we always had the confidence we could raise more quickly, if necessary." When discussing the motivation of seeking out co-development funding, Smith said: "(we could raise money) in exchange for an exclusive use of the technology in a domain within an industry, instead of dilution by selling more stock."

Build the AI machinery first. In allocating resources and evaluating the desirability of undertaking new projects, members of the AI Inc team expressed a desire to prioritise finishing the core AI product over building business applications. As Goodwin stated: *"…*until someone writes me a cheque, let's know what our long term goal is and just work toward it." According to Smith:

> How much resources do we spend on creating the world's first thinking machine--which no-one will ever believe we can do until we do it--versus, devoting resources to a very specific product? The mission is still to build the world's first thinking machine. We're a research company prostituting itself to survive.

There was some disagreement among the team concerning how far this heuristic should be taken, which led to fundamental differences of opinion concerning resource allocation. When a decision had to be made concerning whether or not to accept a Wall Street investment banker's suggestion that AI Inc. build a Wow-enhanced knowledge management application for legal firms, the heuristic "build the AI machinery first" was applied and the offer was refused.

Theoretical Implications: Heuristic Reasoning

Heuristics provide simplifications that limit the need for search in problem solving situations (Harrison 1987), thus enabling rapid decision making in situations in which gaining a full understanding of all relevant factors is impossible. Chess masters use heuristics—such as "dominate the centre of the board"—to find acceptable solutions to complex problems without having to search the entire landscape of possibilities. Heuristics are popular in the field of computer programming and have been developed through the use of genetic algorithms and neural networks (e.g. Gupta et al. 2000).

Different schools of thought have emerged concerning the value of heuristics, and the concept has become somewhat controversial. On the one hand, social and cognitive psychologists believe that heuristic "biases" or cognitive "errors" fundamentally and systematically block effective decisions, lead to fallacious conclusions and cause errors of judgement (Fiske and Taylor 1991). Kahneman and Tversky (1973) identified three main categories of such heuristic biases: 1) *representativeness*—comparing to pre-existing categories or stereotypes, 2) *availability*—overemphasizing memorable phenomena, and 3) *adjustment and anchoring*—adjusting upward or downward from a fixed starting point. Organizational scholars have found evidence that heuristics impair decision-making in corporate acquisition and divestment decision processes (Duhaime and Schwenk 1985), strategic planning exercises (Barnes 1984), or local city council decision making (Drummond 1994).

Other scholars distinguish between relatively static and deeply ingrained *biases,* and "fast and frugal" *heuristics* that are robust to environmental change and generalize well to new situations (Gigerenzer and Todd 2000). Cognitive limitations mean we use approximate methods to simplify complex decisions and take context-specific action in real time (Simon 1993). In high velocity environments, the rough form of probabilistic reasoning underlying heuristics may be an efficient *and* effective way of making decisions if it saves time in

analyzing all possible alternatives and provides correct or partially correct judgements more often than not (Harvey 1998).

Our finding that both management teams we studied used heuristic reasoning supports Eisenhardt and Zbaracki's (1992) suggestion that organizations use heuristics, although the success of the LEGO Mindstorms team calls into question the notion that heuristics typically lead to misdirected strategic planning (Barnes 1984). While Eisenhardt and Sull (2001) propose that successful organizations often apply "simple rules" in making key decisions, it would be incorrect to characterize the rules of thumb we observed in these teams as simple. It is these supplemental characteristics that led us to develop two additional findings.

Finding #2: The Heuristic Reasoning in LEGO Mindstorms and AI Inc. Involved Narratives

Most studies of the role of heuristics in decision-making regard them akin to "simple and computationally bounded" rules used to evaluate alternatives (Gigerenzer and Todd 2000: 17). However, the rules of thumb we observed in LEGO Mindstorms and AI Inc. were grounded in *narrative*—rather than paradigmatic—modes of logic (Fiske and Taylor 1991). The paradigmatic mode of cognitive function attempts to fulfil the ideal of a formal, mathematical system of description and explanation, while the narrative mode consists of good stories that deal in human intentions and actions, and the vicissitudes and consequences that mark their course (Bruner 1986). The paradigmatic mode favours rigorous classification and explanation according to consensual rules of acceptable evidence, while the narrative mode of logic privileges internal coherence to develop themes necessary to understand actors' motivations and intentions, and draws heavily on prior schema (Fiske and Taylor 1991). Rather than paradigmatic simple rules, we suggest the rules of thumb we observed in LEGO Mindstorms and AI Inc. may usefully be thought of as *narrative headlines* developed in each of the two organizations. That is, each phrase briefly summarized more elaborate organizational narratives.

"*Stay in orbit"* called to mind a story with three possible outcomes for the relationship between Mindstorms and the core business: the team could drift too far away and disappear into oblivion; it could get to close to the core and burn up; or it could keep moving but "stay in orbit". Although this story was based on the metaphor of a satellite orbiting a planet, "stay in orbit" was an active story more than a static metaphor; it described how the team could mediate tension between the two entities by distinguishing and including at the same time. In the words of The Senior Executive Vice-President: "stay in orbit means remaining sufficiently apart to find one's one paradigm, but close enough to communicate, i.e. within the perimeter of tolerance".

"Parallel process" evoked an overall narrative of how the Mindstorms team could complete its task more quickly than normally possible in the LEGO company because it progressed on several development tasks at the same time—like a parallel-processing computer—rather than the more usual sequential product development process. The overall parallel process story included sub-stories that detailed incidents where the team was able to quickly identify new problems coming up to the surface. The Mindstorms project manager recalled: "because we are doing the parallel development, we see…things that we would not see if we did not have the time pressure."

"*Be a real partner*" summarized the story of how a "lean" core team could take on much larger competitors by building a network of alliance partners. Team members stated that by "being a real partner", they would be able to put in place many of the building blocks for developing a network of customers and partners. Recalled Sinclair: "the power of the LEGO group is actually insignificant compared to the power of the network that we could build". This story had the potentially happy ending of fostering a broader network of customers of the finished Mindstorms product.

In AI Inc., "*hire based on intelligence*" drew on a script-like storyline in which intelligent individuals with ideas were drawn to the firm, and would be intrinsically motivated to be part of the effort to build the first "worldwide brain". The IT Director described the process as follows:

"The way that people are hired, someone has a good idea and then we decide, 'let's hire someone to write the code to do that'." The primary hiring criterion would be intelligence, rather than specific competences.

"*Avoid dilution*" called to mind a classic start-up story in which the founders led the development of a company that succeed by not ceding control to external parties such as venture capitalists. Evidence of this storyline appeared in the company's April 2000 strategic plan: "This option (securing a large investment to conduct 2-5 years of R&D) was deemed undesirable because the amount of funds required to pursue it would require us to immediately hand over control of the company to the major investor".

"*Build the AI machinery first*" evoked a story of an organization that was trying to change the world through its new AI paradigm, and that would not want to be overly distracted along the way by the need to build revenue-generating applications. This story had a particularly happy ending, evident in Goodwin's comment that "after Wow is finished, the rewards will take care of themselves and we will be richly compensated in a variety of ways".

Theoretical Implications: Narrative

Storytelling can inform decision-making processes in organizations because it helps us consolidate our experiences to make them available in the future, either to ourselves or to others (Klein 1998). Brown and Duguid (1991) found that storytelling allows individuals to keep track of the sequences of behaviour and their theories, and thereby to work towards imposing a coherent, causal account on apparently random sequences of events to decide what to do next. Stories thus also act as repositories of accumulated wisdom. Good stories are packages of different causal relationships, and the more complexity and subtlety, the more there is to be learned (Klein 1998).

Organizations have been compared to collective storytelling systems in which stories are performed as a key part of sensemaking (Boje 1991). Barry and Elmes (1997) propose that the ability of stories to handle the simultaneous presence of multiple, interlinked realities, makes them useful for capturing the diversity and complexity present in strategic discourse. Storytelling is an inherently social process, and the insights accumulated are not private substances, but socially constructed and distributed (Brown and Duguid 1991). To the extent that narratives are linked into broader discursive structures that influence their interpretations, they can be used to justify and legitimise actions (Vaara 2002).

The LEGO Mindstorms and AI Inc. rules of thumb can be thought of as headlines of broader shared narratives that, when invoked, guided decision-making in each team's high velocity environment. However, we also found that these narratives were not merely rational, cognitive repositories of wisdom, which leads us to our third and final research finding.

Finding #3: The Heuristic Reasoning in LEGO Mindstorms and AI Inc. drew on Emotional Content

Another element distinguishing the heuristic reasoning used in these two organizations was the strong emotional content the heuristics seemed to hold for team members. By emotion, we refer to a "complex assortment of affects, beyond merely good feelings and bad, to include delight, serenity, anger, sadness, fear, and more" (Fiske and Taylor 1991: 411). Emotional factors appeared to influence how team members processed information coming both from their external environments and from within the team itself, lending extra weight to the narrative headlines when evoked.

Stay in orbit allowed Mindstorms team members to retain some of their emotional connection—very strong for many team members—to the LEGO organization, while balancing a competing desire for autonomy. A product development engineer outlined his

emotional reasons for wanting to remain separate from—yet attached to—the LEGO company.

> After working 3 years inside LEGO R&D and not seeing some of my ideas on the shelves, we had the chance to make Mindstorms…I hope very much that a lot of fathers, together with their boys, will sit and work together on this and have fun. When I was 10 years old, my father and I we made model trains…but I can see today that if we had had those pieces in those days, wow!

Parallel process called to mind a pride in the team's ability to function and proactively spot potential problems far more quickly than the more mechanistic parent company. As a purchasing manager commented: "The (development engineer) from Mindstorms did all he could for that product, his heart was in it. The Mindstorms people think of the product as part of their own success, not just as work to be done from 8am-4pm."

Be a real partner became a rallying cry among team members to build relationships with partners not merely for short term economic gain, but also to create a broader-based movement. Fulton explained:

> Building a community is a job you absolutely have to do with others…you almost have to have a higher purpose for it to work... LEGO is not great because we have a lot of money. LEGO is great because we have a lot of great content, and we have a very deep philosophy.

In AI Inc., *hire based on intelligence* drew on the pride of organizational members to be considered part of such a group of "intelligent" individuals—the elite in the world of AI. As one network administrator commented: "These people are brilliant, and I am very humble with them."

Avoid dilution made clear that a primary goal of the organization was not short term economic gains and security, but rather a desire for control over one's own work. Intrinsic motivation was expected to reduce the need for hands-on management, as Goodwin explained: "I try to let them do what they've always dreamed of doing within a Wow context."

Build the AI machinery first drew upon the aspiration of team members to be part of an AI "revolution" that had the potential to change the world. Explained one programmer: "I view this job as one of the greatest opportunities I've ever been afforded".

Theoretical Implications: Emotions

Albrow (1992) describes the silence on feelings as a 20th century aberration at odds with earlier understandings of organizations. Thagard (2001) has claimed that emotions play a significant role in the process of scientific discovery, while Callahan (2002) has proposed that emotions can become external or social phenomena that contribute to the emotional structuration of organizations. Yet while emotions have more recently been the subject of some study within the realm of cognition research (Fiske and Taylor 1991) very little fieldwork has been conducted in this area in the field of management.

Most of the existing literature on emotions and management studies implies that emotions are something to be managed and suppressed, principally on the grounds that they interfere with rationality. However, Langley et al. (1995: 261) point out that decision makers are also driven by emotion, imagination, and memories, which "are punctuated by sudden crystallization of thought". It has been suggested that emotions can serve rationality, with negative emotions such as anger underlining the credibility of threats, while love and affection support the credibility of promises to cooperate (Fineman 1999). Also at odds with purely rationalist approaches to decision-making is Korsgaard et al.'s (1995) finding that achieving positive affect within a team did *not* adversely influence the quality of decisions.

Emotions can alert and focus individuals to important environmental changes and help them prepare appropriate response strategies, as well as anchor important events in an individual's long-term memory (Scherer and Tran, 2001). Shrivastava et al. (1987) emphasize that organizational members are feeling, emotive, affective, human beings, who often make decisions based on an emotional understand of issues. Although at times problematic (Martin

et al. 1998), the creation of emotional needs and their satisfaction in organizations can give rise to a distinct form of emotional rationality that underlies organizational action and influences the cognitive components of organizational frames of reference.

Overall Finding: Guiding Principles

Our fieldwork has led to three key findings concerning how organizations in high velocity environments make decisions. These findings are first order concepts—observed "facts" and interpretations used by members of the organization. In order to improve the study's criticality, we have used these concepts to generate a second order finding—an interpretation of interpretations (Van Maanen 1983)— called "guiding principles". Guiding principles call to mind deeper narratives shared within a management team, which when invoked, provide access to far richer guidance on effective courses of action. Such narratives help managers we observed keep track of and consolidate their experiences, making them available both at the time and in the future. Their emotional content anchors the narratives in managers' long-term memories in a stronger manner than a purely rational chain of events. Guiding principles are fundamental justifications for rules and judgements (Kessels 2001) that differ from norms (e.g. Harrison 1987) or interpretive schemes (e.g. Bartunek 1984), in that they embed self-referential storylines to which team members feel emotionally attached (Oliver and Roos 2003) *(see Table 1 for an illustration of how each guiding principle was applied)*..

--insert Table 1 about here--

A principle has been defined as a general truth on which other truths depend—a fundamental that can be reached by induction (Peikoff 1991). Principles integrate our conceptual knowledge at an appropriate, "mid-range" level of abstraction (Locke, 2002: 198). Although simplifying complicated organizational and business environments in the manner of heuristics, guiding principles do not outline various kinds of detailed decision criteria. Instead, they call upon narrative logics and forms of understanding among individuals, and are used to guide

specific actions in specific contexts. Guiding principles are thus not as specific as “simple rules” (Eisenhardt and Sull 2001), but they may constitute a form of foundation upon which such rules can be developed.

We propose this term for two main reasons. First, we believe that “guiding principles” more closely describes the decision making processes in the organizations we studied than any of the existing terms in the knowledge structure literature, many of which are burdened with cognitivist history and assumptions and thus cannot be easily broadened to include narrative and emotional decision-making logics. Second, it is our hope that by presenting this new term within the context of an empirical study and situating it within its broader nomological net (Cronbach and Meehl 1955), we will prompt further research in this domain.

Conclusion and Future Research Directions

In this paper we set out to build new theory about decision making in organizations operating in high velocity environments. We began by reviewing the literature on cognitive knowledge structures, which have long been thought to guide such decision processes. We then critiqued this literature on the basis of its overly simplistic assumptions related to: 1) the singular nature of “decisions”, 2) the purely rational basis on which good decisions should be made, and 3) the isolation of decision processes from their social contexts. Much of the data has been gathered in laboratory settings rather than in the field, and has typically sought to measure decision quality using a variety of dependent variables. Very few studies have attempted to explore decision processes in high velocity business environments characterized by high degrees of instability.

We sought to address some of the shortcomings in the literature by conducting interpretive field studies of actual decision making processes in two separate organizations operating in high velocity environments, which led to three first-order findings. First, the management teams we studied tended to use heuristic reasoning in making their decisions. Second, the

rules of thumb these teams used were not purely cognitive devices, but invoked as headlines of broader organizational narratives. Third, these rules of thumb carried considerable emotional as well as cognitive weight with management team members. We then proposed a second-order finding— "guiding principles"—which describes heuristic-like devices that draw on narrative and emotion to guide decision making in high velocity environments. This finding extends the existing literature on knowledge structures by moving beyond paradigmatic and purely cognitivist "if-then" decision processes.

Future research may usefully examine some of the process issues involved in developing guiding principles. For example, the guiding principles we observed in the LEGO Mindstorms team were developed in the course of discussions between Sinclair and team members through a cyclical process, emerging through a combined process of bottom-up team member participation and top-down team leader suggestion. On the other hand, those of AI Inc. appeared to emerge in more of a traditional top-down manner, although they were subsequently picked up and repeated throughout the organization. While we did not focus on any performance impacts associated with different guiding principle development methods in this study, it is interesting to note that the Mindstorms team was far more successful than AI Inc. What is the impact of the development process of guiding principles on their subsequent use? Might guiding principles developed in a collaborative manner be more widely used and helpful than those that were not?

Further questions relate the nature of the narratives and emotions that underlie guiding principles. Several scholars have called for more use of narrative analysis in organizations (e.g. Dyer and Wilkins 1991), and further research into the connection between emotion and knowledge structures has already been referred to as "one of the most important new research directions the field can take" (Walsh 1995: 307). Are some narrative forms and particular emotions more salient than others in guiding decision-making? By improving our understanding of guiding principles along these lines, we may be able to complement this initial descriptive study with prescriptive work on how they might be intentionally rendered visible and shaped in organizational settings.

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Table 1: Illustration of Findings and Guiding Principle Applications

Case site	**Decision Issue**	*Heuristic Reasoning*	*Narrative Mode*	Emotional Content	**Guiding Principle**	**Decision Outcome(s)**
LEGO Mindstorms	Develop shared public relations statement with parent	Maintain autonomy for Mindstorms without cutting the team off from LEGO's resources. "*It's a struggle for Mindstorms to keep moving and not get sucked into the core business—to stay in orbit*".	Called to mind story with three possible endings: *"The team could drift too far away and disappear into oblivion, it could get too close to the core and burn up, or it could keep moving but "stay in orbit".*	Many team members *desired* to remain separate from, yet attached to, the LEGO company. *"The engineering guy from Mindstorms works like hell, on his own. He burns for this product."*	Balance autonomy with connection to LEGO. *"Stay in orbit"*	*Agree to common statement while affirming team's independence*
LEGO Mindstorms	*Plan hardware and software development*	Conduct multiple tasks concurrently rather than sequentially. *"(Our team) is characterized by a kind of multitasking-doing several things at the same time"*	The team worked faster and identified emerging problems more quickly by mimicking a parallel processing computer. *"Because we are doing the parallel development, we see a lot of problems coming up to the surface"*	Team members took *pride* in their ability to spot problems faster than parent. "*I was getting exhausted from all our parallel processes—it never stops. You get energy from the excitement but it can wear you out"*	Work faster and smarter by running processes concurrently. *"Parallel process"*	Develop hardware and software at the same time
LEGO Mindstorms	Select product development and distribution partners	Treat partners as equals wherever possible. "*In building a Mindstorms community, I've learned that it's critical to have equal partnerships…* *we would destroy the whole thing if we tried to control it".*	The team generated interest and ideas extending far beyond LEGO. *"(We) work with a network of partners—that is the only way we can be really competitive… opportunities pop up through the network."*	Team *wanted* to create a movement, not just another product. *"We want our partners to feel a sense of ownership for joint projects…because they have competences as equal partners".*	Build a worldwide network by treating alliance partners as equals. *"Be a real partner"*	Select partners who would not attempt to dominate Mindstorms
AI Inc	Make hiring decisions	Hire based on raw talent rather than fit. *"I will take enthusiasm and general intelligence over specific experience".*	Intelligent staff would be intrinsically motivated, self-organize, and build the world's first worldwide brain. *"Because everyone's doing what they always wanted to do all their lives anyway…we don't have to pay them as much".*	Employees *proud* to associate with intelligent colleagues, and with Goodwin. *"The respect that (Goodwin) carries with our top scientists holds that team together".*	Build team of intelligent, intrinsically motivated people. *"Hire based on intelligence"*	Hire bright individuals over those with specific skills or experience
AI Inc	Respond to financing proposals from external investors	Avoid relinquishing control. *"We're still playing it close to the edge in terms of risking the viability of the firm to minimize dilution"*	The start-up with a great idea resisted selling out and refused external control. *"Special interests are pulling us apart, wanting exclusivity. We want to let the limbs go, and remain the brain."*	Strong *desire* felt by employees to control their work. *"The company is like a religion, lots of people want to advance AI".*	Maintain control of the organization and its objectives. *"Avoid dilution"*	*Refuse financing propositions*
AI Inc	Make resource allocation decisions related to components	Prioritize the AI technology ahead of saleable components. *"I need to get the thinking machine to work…so managing application development doesn't get as much attention".*	The best way to attract customers is to focus on the core technology. *"If we build a better way of predicting the markets, the world will build a path to our door".*	Employees strongly motivated by *feelings* of the importance of completing an AI revolution. *"AI Inc. is about changing the world."*	Prioritize core technology over applications. *"Build the AI machinery first"*	Allocate most resources to core technology

Endnotes

[i] Individual names in the LEGO Mindstorms case study have been disguised.
[ii] All company, individual, and product names in the "AI Inc." case study have been disguised.