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Building Coherence in a Self-Managed Team: The Development of LEGO Mindstorms

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Abstract

This study attempts to understand how members of a self-managed team made sense of their complex environment, characterized by frequent surprising and potentially threatening events. The authors develop an interpretive case study that draws on narrative and metaphor analysis in order to understand how the LEGO Mindstorms development team responded to critical and surprising incidents during its existence. In facing each of three critical incidents the team appeared to become more coherent, which improved its subsequent ability to act quickly and effectively in its complex environment. By examining the team's actions, the authors derive three interrelated propositions that appear to lead to coherence in times of crisis: develop a shared sense of the team's changing identity, come together face to face, and develop and follow simple guiding principles.

Key Phrases:

Self-managed teams

Critical incidents

Coherence

Guiding Principles

Identity

Presence

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Introduction

How do self-managed teams handle surprises? While the study of groups and teams dates back over a century, much of the existing literature in the field attempts to determine the impact of pre-given variables such as diversity, time orientation, or size, on team performance. Teams are generally assumed to be clearly definable, subject to tight supervision, and to make decisions rationally. Their operating environments are usually rather stable, which implies the teams have some ability to predict and control their future.

It is the purpose of this paper to describe how people collaborate in complex environments characterized by frequent surprising and potentially threatening events. We believe the manner in which teams respond to such events is the most telling indicator of their success, surpassing in importance any single, pre-given variable. This assertion is grounded in our assumption that today's increasingly interconnected business environment--and teams themselves--are complex adaptive systems, in which relatively small events can lead to the outright success or failure of a team's effort.

Understanding the qualitative nature of a team's response to these incidents calls for longer-term, case based research methods that are sensitive to context, as opposed to traditional cross-sectional data collection techniques. It is the intention of this study to shed more light on how complex teams operating in a complex business environment actually function, and develop three interrelated propositions that describe methods one team adopted to improve its overall coherence and performance.

Self-Managed Teams

It has become increasingly clear to many large organizations that traditional organic, evolutionary change processes (Burns & Stalker, 1961) are too slow in environments that are increasingly high-velocity and complex (Bourgeois and Eisenhardt, 1988; D'Aveni, 1994). In

order to improve their ability to adapt to and shape their environments (Oliver and Roos, 2000), a growing number of large corporations is turning to the use of teams[1], assuming rightly or wrongly that they lead to unquestioned benefits (Knights and McCabe, 2000).

In response to the increased prevalence of teams, the literature on "teams" (the most common term used in practitioner-oriented literature) and "groups" (more frequent in the social psychology literature) has grown markedly over the past decade. The study of teams has been informed by decades of study into small groups within the realm of social psychology (e.g. McGrath and Kravitz, 1982) including the well-known "Hawthorne" studies (e.g. Homans, 1950). In this paper, our focus in on teams, which drawing on Cohen and Bailey (1997) we define as a collection of individuals who are interdependent in their tasks, share responsibility for outcomes, see themselves and are seen by others as an intact social entity embedded in larger social systems, and manage their relationships across organizational boundaries.

One area of team literature that has attracted increasing attention is the study of the "self-managed project team". Used by an estimated 68% of Fortune 1000 companies surveyed (Lawler, Mohrman, and Ledford, 1995), self-managed project teams are distinct in that some elements of traditional "management" are incorporated within the team itself. Such teams are commonly used to develop and implement radically new product/market combinations in high velocity environments (Bourgeois and Eisenhardt, 1988), in which there is rapid and discontinuous change in demand, competitors, technology and/or regulation.

The study of self-managed teams has typically involved the search for directional and causal relationships between various key team factors and the team's overall performance. Some of this work has found associations between a team's performance and its size (Campion et al, 1993), external orientation (Ancona, 1990), cohesiveness (Cohen and Bailey, 1997:281), and "at stakeness", transparency, mindfulness, and synergy (Jassawalla and Sashittal, 1999). Some more surprising findings include inverse relationships between performance and

[1] Grady (1992) found that 82% of companies having over 100 employees report to using teams.

diversity (Ancona and Caldwell, 1992), and performance and encouraging supervisory behaviours (Cohen et al., 1996). Other studies have found that team autonomy is generally associated with higher levels of satisfaction but not performance (Cohen and Ledford, 1994), although Barker (1993) found that full autonomy can simply lead to new and sometimes greater pressures.

Impressive as this literature is, the overwhelming majority of it was conducted within the logical positivist research paradigm. Much of the social psychological literature on groups has involved the use of laboratory experiments to study groups as context-free, closed systems over short periods of time. Such groups have no history and their members have no expectations for the group following the experiment. Much of the work on teams depends on cross-sectional survey data collection methods, in which teams are assumed to be clearly definable entities that make decisions rationally and in isolated contexts.

This research approach contrasts with actual self-managed teams in organizations, which always operate in a historical context and often are highly meaningful to their participants. In facing high-velocity business environments characterized by frequently surprising events, self-managed teams have only limited capabilities to predict and control the future. Little of this literature attempts to understand how organizations really operate in such environments.

Collective Mind and “Hot Groups”

In contrast to these traditional approaches, theorizing has also occurred around two constructs that appear to hold some explanatory promise to describe how effective teams operate in complex environments. The first notion we will review here is “collective mind”. This construct is grounded in functionalist assumptions of “mind”, in which the existence of mind depends on the capacities of the parts and their interconnections (e.g. Block, 1980). Collective mind theorists posit that groups having "collective mind" are better able to notice, comprehend, and respond to unexpected events, and can thus achieve far more together than would be possible as a collection of separate individuals.

Building on earlier work by Asch (1952), Weick and Roberts (1993) propose that collective mind on aircraft carriers develops through team members interrelating “heedfully” with each other, which involves cognitively representing, contributing to, and subordinating to the group. When individuals develop a shared understanding of the group’s tasks and of one another—when they interrelate in a “heedful” manner—a group-level or collective mind can emerge. Other collective mind theorists have looked for and found evidence of collective mind in “sustained product innovation” processes in certain firms, and proposes that firms should organize themselves according to collective mind rather than coordination principles (Dougherty, 1998). In their study of software requirement development processes, Crowston and Kammerer (1998) compared approaches involving coordination theory—in which tasks are decomposed into pieces small enough for a single individual to work on--with collective mind, in which individuals understand how their work contributes to the work of the group. They found that individuals in groups operating as “collective minds” could more successful anticipate the actions of others, and spend less time checking or asking. Kirley, 1999 looked at the relevance of collective mind theory for human resource development, and Brockmann and Anthony 1998 considered collective mind /heedful interrelating useful means of surfacing tacit considerations in strategy sessions.

Many conceptions of group mind have become controversial because they seem to imply the existence of some super-individual entity. Morgeson and Hofmann, 1999 warn of the dangers of reification and personification when ascribing human, individual attributes to collectives. The role of interactions appears to be the fundamental building blocks upon which collective structures are built (Giddens, 1993:128), and human agency in the face of such interactions is how social structures are both constituted and impact others. Such work suggests that in order to avoid reification, interactions that allow collective constructs to emerge and sustain themselves should be the unit of analysis.

More recently, the construct of the “hot group” has been developed to explain the existence of highly effective teams (Lipman-Blumen and Leavitt, 1995). Hot groups are “lively, high-achieving, dedicated groups, usually small”, whose members develop a shared, single-

minded, and obsessive dedication to a challenging task. Lipman-Blumen and Leavitt (1999:65) found that unlike earlier theorizing about teams, the “heat” of such groups does not appear to be related to any easily identifiable, individual factors, such as member IQ, personality, social rank, professional status, race, gender, and political affiliation. Such empirical findings appear to call into question much group research to date, especially underlying assumptions of rationality and stability.

Aside from pointing out factors that do not drive the actions of hot groups, the authors do little to explain what leads groups to become “hot”. They do not explain how members of hot groups are pulled along by “the magnetic pull of the task”. They say little about what drives these groups, how they function on a day-to-day basis, or how they should be managed. Hot groups, are regarded with some mysticism, and the role of management would appear to extend only to recognizing hot groups post hoc. A similar critique could also be applied to the collective mind construct. In both cases, little explanation is provided as to how “mind” or “heat” actually emerges and is sustained in practice.

Method: Interpretive Case Study

Attempting to understand teams operating in complex environments presents some methodological challenges. In such environments many traditional research approaches are hampered by the presence of multilayered and changing contexts, multidirectional causalities, and feedback loops (Langley, 1999). We believe the study of such teams requires abandoning traditional cross-sectional data gathering techniques, in favour of more qualitative case-based study. Kozlowski et al, 1999 emphasize that teams are not simply the sum of their individual parts, and call for further study of the interdependencies among members rather than to their individual abilities. Teams should be regarded as ongoing processes, not isolated events. Such processes develop and adapt to external contexts over time, thus should be studied over appropriate periods of time (Arrow et al, 2000:29). In order to understand a team’s response to unexpected events teams should be studied within their contexts, and such data collection involves, plunging into the processes themselves, collecting fine-grained qualitative data, and attempting to extract theory from the ground up (Langley, 1999).

We use process data to develop a case study describing how one self-managed project team handled critical incidents. By “critical incident”, we mean sudden events with a major impact on potential survival of the team and/or its intentions. This work is interpretive, because we are most interested in the meanings being constructed by the individuals involved--the *emic* meanings they hold (Stake, 1998). In our analysis we consider the team and its larger organization to be social collectives that are produced, reproduced and transformed through the ongoing, interdependent, and goal-oriented communication practices of its members (Mumby and Clair, 1997).

Individuals construct meaning around events they experience, and disruptive critical incidents may provide opportunities for participants to construct new meanings. We sought out ways its members made sense of and experienced the team, its critical incidents, and its situatedness in its environment, by analyzing accounts provided by individuals from the team, especially stories, anecdotes, metaphors, and narratives (e.g. Czarniawska, 1998; Lakoff and Johnson, 1980; Tsoukas and Hatch, 2001). Through analysis of the narratives recounted by team members, we develop categories that led to propositions concerning how the team handled the critical incidents it faced. As with other postpositivist research, validation of interpretive case studies cannot be developed in a purely objective manner. Conceptualizations developed with such a context-dependent approach may be judged based on their logical development, and the soundness their fundamental views of human nature, organizational requisites, or societal processes (Whetten, 1989).

As the research site, we chose to study a self-managed project team launched by the LEGO company to develop a new business opportunity in an area on the boundary of the toy and computer industries. We studied the team for a period of 24 months, from the time it was established until the aftermath of the highly-successful launch of LEGO Mindstorms. Between May 1997 and May 1999 we prepared extensive field notes, conducted 27 in-depth interviews of both members of the LEGO Mindstorms team and people in the parent LEGO organization, and analyzed secondary data including memos, other internal documents, press releases,

etc. In examining the data, we have sought to gain a better understanding of how this team constructed meaning around events it experienced.

During the two years of our study, the team faced several critical incidents. Each incident was followed by an "avalanche" of subsequent events that led the team to re-evaluate its current activities and take unanticipated actions. Rather than attribute such incidents to insufficient planning or ineffective coordination on the part of the team and/or its leader, we focus entirely on how the team handled these incidents as the single most important indicator to its ultimate success or failure. In this paper, we briefly describe three such incidents from our interpretive case study, and extract from the team members' narratives of some categories into which their actions can be classified.

The LEGO Mindstorms Story

Mindstorms was launched by the multinational LEGO company as a response to the growing threat from new competitors and the challenge represented by the rapid spread of the Internet and technology-oriented toys. LEGO management had found it difficult to encourage the development of radically different products to counter these challenges. One senior vice president did start a project to look into ways for LEGO to create a product that could compete with children's at-home alternatives such as video games, but the project languished until Sam Sinclair[2] left his job with an information technology company to take over the project and found a new team with LEGO product manager Frank Fulton in 1996.

The Mindstorms team was set up as an autonomous project unit, reporting directly to the senior management of LEGO, but located within the educational toy part of the company, far from the view of most of the organization. "We started in the corner of the corner", recalled Fulton. The project was considered important because it would potentially represent a new direction for the LEGO company--taking it into what was at the time the relatively unexplored realm of computerized toys. Yet it was expected to be difficult, as the company had little previous experience in dealing with computer-based products. Because the new product

[2] The names of the individuals in the LEGO example have been disguised.

crossed the boundary between the toy and computer industries, it could not easily be developed and evaluated using traditional strategic management techniques common in either one of these more-established industries, such as Porter's five-forces or value chain analysis models.

The two founders were given a mandate to take some partially developed technology, develop an original product, and bring it to market. From the beginning, they set out to operate in a way quite different from that of the LEGO company. The team operated using highly unconventional procedures, as they claimed to disregard hierarchy. "We threw away most of the rulebook, and operated like a small, entrepreneurial business," said Fulton. The team believed that only by operating in this way would it be able to successfully launch a radically new product in a tight time frame. Although the team would be allowed a high degree of autonomy, it would also have to obtain resources from within the parent company's existing matrix structure, meaning individuals who were engaged to work on Mindstorms continued to have "normal" responsibilities and report to line managers within LEGO.

Over the two-year period, the team grew from its original two members to include a total of 15 individuals representing several nationalities from a variety of different parts of the organization, industry backgrounds, and locations—including the United States, Britain and Denmark. The team's diverse composition and unorthodox operating style drew our attention as management scholars to its efforts. Although we did not know at the beginning of the data collection process how the project would end, the product that emerged at the end of the two-year period was highly successful, exceeding all of the team's sales predictions. We believe that the team's ability to launch such a product in such a short period of time compared with other parts of the organization makes it a particularly interesting case site for research purposes. We now turn to very briefly describe three emergent incidents that had major impacts on the Mindstorms team.

Critical Incidents

First incident: May 1997

External marketing experts reported that the software portion of the product was not age appropriate or consistent with the LEGO style; they doubted that Mindstorms would sell in its current form.

Just as the team was expanding beyond its original two members in early 1997, it received the surprising news that its early development product might be too complicated for its target age group. The team responded by calling a two-week "time out", bringing together all five members of the core group from different countries, to go over the problem in detail. The team excluded from its "time out" members of the parent company and the team's alliance partners, including its various external marketing, public relations, and technology partners.

Bob Baker, the Mindstorms project manager, reflected on the need for this time out given the rapid pace of the team. "We were going so fast in our product development, that when we suddenly found a very serious problem in our product, we had to act immediately. It was really hard to see this problem a week before because it wasn't there". Fulton recalled: "sometimes, you are moving so fast that you don't know where you are…we couldn't go through months of testing of Mindstorms like they do in the rest of LEGO because we had to be fast." Sinclair and Fulton also believed the time out would help them inculcate the newest team members, including their new US based marketing director, Jane Johnson. "We wanted time to fully integrate Jane into the project, we wanted to make sure she felt like she owned it", recalled Fulton.

During the course of the two-week time out, the team developed a two-page paper outlining objectives for the new brand, and strategies for building and launching the brand. At the top of the page was a boxed paragraph describing the team's ambitions for itself: "We will establish the LEGO company as the leading supplier of child centred robotics in the…mass consumer market". The team spelled out that this would involve establishing an entirely new category, which would combine the parent company's traditional strengths with technological innovations. They also came out with an extensive list of how the new product would be positioned towards its market, how it would be launched, and the (non-traditional) distribution

channels they would use to aim at what they called “the grey zone” on the boundary between the toy and computer industries

The team then set out to create what Sinclair described as “an entirely new business system, emphasising speed to market, alliances with carefully selected partners, high annual novelty share, a close relationship and interaction with the consumer, and lean, globally centralised operations”. As Fulton recalled “everything you look at in Mindstorms is different. Nobody else is doing it this way. We are establishing a new business system that is lean in the middle, trying to cut out distribution stages of the business system and applying much more emphasis on being close to customers, including developing an Internet community. We are developing entirely new sales channels.”

When news of the “time out” became know by the parent company, some individuals in LEGO took this to mean the project was on the road to failure. The team responded with a memo sent to everyone connected to Mindstorms within LEGO, letting them know that the project was still on track, that one part of the project was on “time out”, the rest was proceeding very well. Sinclair also briefly described to them some of their ambitions for the new product. The team had to strike a balance in their relationship with their parent company. It needed its resources and expertise so could not ignore their comments, yet he wanted the Mindstorms team to remain autonomous. Sinclair described the balance he tried to strike using the metaphor of a satellite: “What is the right distance from the core to put business development? If you are too close to the core, you get sucked in and burn up, If you drift too far out, you get lost.”

Second Incident: June 1997

Mindstorms was instructed to coordinate its public relations launch with that of one of the parent company’s more traditional toys, and develop “one corporate statement” to transmit to customers. Many within LEGO did not see many differences between the two products.

The first reaction of the Mindstorms team was one of frustration. They believed their product represented an entirely new direction for LEGO, whereas the parent company's product was merely a brand extension. The team was concerned their message to the public would end up being excessively watered down by having to combine their launch with that of the more traditional LEGO product. Sinclair explained: "In a big organization, coordination is nice. But in the spirit of cooperation and coordination, the message can become blurred and meaningless."

Sinclair believed some of the impetus for this decision arose from internal competition between his team and the parent company. The budget for the other LEGO product was four times the size of that of Mindstorms, and his team was concerned about being "swallowed up." Fulton explained: "Our product is vulnerable with respect to the LEGO Group, we need to make sure we get a clear message out that it is something really new and different". Said Sinclair: "We want to try to retain the cell membrane of Mindstorms."

The teams had very different operating styles. While Mindstorms prided itself on making fast decisions, the parent LEGO company was slower. One of the parent company's mottos of which it was most proud was "only the best is good enough". Instead of the more hierarchical parent company, the Mindstorms team eschewed titles internally, only using them when dealing with the outside world. Engineers working on the two projects felt the differences. Recalled Gordon Grady, a LEGO engineer: "The guy from Mindstorms did all he could for that product, his heart was in it. The guy working on the LEGO product took a holiday right in the middle of a very critical phase!" Another recalled that: "Sinclair has been very heavily involved in this project, and has guided us closely in our work, more than other managers". Baker recalled spending a great deal of time talking to team members, negotiating how long things would take. "It takes a lot of my time, and the LEGO organisation isn't used to all this communication", he recalled.

The Mindstorms team responded first by putting out a position paper explaining the differences between the two products, which was followed up by a presentation made by

Sinclair to senior management from the entire company. He realized they had little idea of the differences between the products. “Some senior managers told me that we wouldn’t be able to sell a product that cost over $19.99” he recalled. “They were also thinking about our traditional toy company rivals, instead of our new competitors from the computer industry which we would have to face.”

The overall approach in dealing with alliance partners also differed. Whereas the LEGO company sought to work with a small number of partners on what Fulton referred to as a "make that" basis, the Mindstorms team set out to work with a wide range of partners, preferring to “build on existing infrastructure developed by partners wherever possible”. They also set out to work with partners as equals. Sinclair explained: “we would destroy the whole thing if we tried to control it.”

In August, the advertising agency responsible for the launch developed a common message that was much more aligned to that of the LEGO product than to Mindstorms. Concluding that the agency was only interested in the parent company’s business, the team stepped up its internal and external communication efforts emphasising the product differences. After considerable effort, a new agency was chosen for the launch. When the launch occurred in January 1998, the Mindstorms team found that it’s efforts to clarify its message paid off, with its product attracting an estimated 80% of the media’s attention. The launch was considered the most successful launched by LEGO in several years. Fulton was pleased with the new advertising agency’s efforts: “The other product was backed up by the core group, they had lots of power but our philosophy was really different and we ended up attracting 80% of the media’s attention. This shows the importance of your partners sharing your core values.”

Third Incident: August 1997

“I could sense it was drifting apart, and some small conflicts were starting. They were spending too much time discussing how much power people should have”, recalled Sinclair. Some infighting began in the team, and members wanted more clarity about their positions.

This critical incident arose more slowly, but quickly came to a head in August. Recalled Sinclair: “As we got up to fifteen people, with half in the US and half in Europe, people were beginning to spend too much energy on discussing how much power somebody had.” Fulton explained: “The problem was that people weren’t discussing between them: they talked all the way around it… people weren’t confronting each other with their differences of opinion. We had to make people talk directly to each other about this.”

Sinclair attempted to respond to the growing problem within the team by drawing up an organisation chart for Mindstorms. Not surprisingly, given the complexity of the team and its interconnections, the chart was five pages long. He explained: “I’m trying to move people to where they would be best, some people have specific capabilities and want to do specific tasks. I want to define some boxes and try to move people around afterwards.” While Sinclair showed team members the chart on his laptop computer, he seemed uncomfortable about depending on it too much. “I didn't publish it or didn't print it, and whenever we went over it, I went over it verbally.” His discomfort with the organisation chart led him to later abandon the idea, stating: “Everybody in the Mindstorms team understands that the organisation cannot be formalised, it needs people with a high threshold for uncertainty.” He pushed for more communication within the team in order to solve problems as they arose.

He himself adopted a highly communicative style of team leadership, recalling: “I call my people all the time, from my car, to ask them how things are going. I pass by, chit chat, for a few minutes. Employees are like bank accounts, if you just deposit money regularly, they grow like crazy!” His management style surprised other managers in the LEGO organisation, who found his approach overly communicative. Sinclair recalled: “Sometimes people tell me: ‘you do too much micromanagement’. I call it leadership. Our team induces a great need for communication, and the (LEGO) organisation can’t handle it. We want to parallel process wherever we can”.

It was certainly true that many of the processes within the Mindstorms team were hard to manage. According to one team member: “Our processes are chaotic. Everybody has

different focus in what they're doing, which is very taxing". The geographic spread of the team added to these challenges. At times, it was necessary to bring people together. One of the engineers recalled a critical stage of the development process: "we spent three whole days together in a meeting room, trying to specify what this was going to be. We knew it was risky, and it was really just our best guess. But having the hardware and software people together was good, because we could build a prototype, and make small changes in the program and two hours later we could try it out". The team decided to establish one weeklong, face-to-face meeting every month for the core group.

Yet the increased communication was not always easy. Recalled one manager: "It takes time to explain everything to everyone all the time." However this intensive communication also brought benefits. Baker recalled: "because we are doing the parallel development, we see a lot of problems coming up to the surface, and also things that we would not see if we did not have the time pressure, and did step-by-step, systematic product development like LEGO would do. Explained Fulton: "The most important thing in a process like that is that the people involved discuss. Everyone in the team is responsible for finding a solution."

Findings and Discussion

Based on our interpretation of these and other critical incidents faced by the Mindstorms team, three main categories of team responses emerged. In this section, we describe the each of three key findings, situate each within existing literature, and develop three propositions for further research.

1. In the face of uncertainty, know more about your changing self.

In facing each critical incident, we observed that one of the first action the Mindstorms team members took was to spend time talking about what their purpose was, defining what kind of a team they wanted to be, and why they were there. In the first incident, they called a time-out to focus on themselves, integrate new members, and put out a clear message to those around them. They found it important to write down some of the outputs of these sessions--

which took the form of their descriptions of what the team was, how it looked, what it wanted to do, and how it was going to do it.

We interpret these discussions as their effort to focus attention on their changing identity as a team. Developing an awareness of our current self is critical to our ability to act, yet our "self" changes over time, as our identities as individuals, teams, and organisations are constructed. Our ability to even recognize that we have identities is part of our very human capacity to distinguish between "I" and "me", in other words, to know in both subjective and objective ways (Mead, 1934). In addition, it appears that our physical embodiment plays a significant role in understanding who we are (Hayles, 1999). Although they can change over time, our identities serve as useful guideposts for dealing with an increasingly complicated world. For all its vagueness, identity provides us with legitimacy for our actions, and a sense of continuity.

A large part of this team's identity development was defined using metaphors (for example, the Mindstorms "cell membrane" and "satellite"). Such metaphors created a context within which they could know themselves better, the team influenced what it would see—what it considered important, who were its target customers, and which alliance partnerships would make sense. Distinguishing themselves from their parent company was a choice they made that would go on to have implications for their actions later. Acknowledging and changing who we are is also a critically important step in strategy making (Oliver and Roos, 2000).

The Mindstorms team worked on several occasions to develop a conception of its own identity both in relation to individual team member identities and those of larger structures such as the parent company. We interpret this task as its effort to construct an identity that aligned with both individual and company considerations. Having an aligned identity may have allowed the team to act more coherently, as decisions made in accordance with this aligned identity—such as the establishment of working relationships with partners-- would have made more sense to the team than those that did not. The Mindstorms team thus implicitly considered identity to be a complex entity, rather than a simplistic statement to be

imposed on all members of the team. Complex identities cannot be captured by organizational charts (even ones that are five pages long), a notion borne out by Sinclair's discomfort with developing such a chart. Organizational charts can even be damaging to the degree they misrepresent actual practice, and provide a team with a false sense of stability. The complex nature of the team and its environment meant that any identity alignment could only be temporary, and must be regularly reassessed (Letiche and Lissack, 2001), a process the team underwent through its regular face-to-face discussions.

A great deal of the Mindstorms team's sense of self was also grounded in its members' strong emotional responses to the team's identity. Affect-driven or "hot" cognition (Abelson, 1963), influenced how members of the team processed information in their environments and in their team. It appeared to play an important role in the strength of the team's identity-development efforts, and likely in its ultimate success as a venture.

Proposition #1: Because it influences how members will act, a shared understanding of a team's identity helps members effectively adapt to and shape their environments in the face of critical incidents.

2. In the face of uncertainty, be more present

Our second observation from the data concerns the importance the team placed on physical proximity. The team had a number of major breakthroughs following discussions held when members were together for extended periods of time. For example, the team's "time outs" helped enable them to sort out problems concerning positioning, identity development, and software issues. When they faced technical problems they commonly put multi-functional teams together in order to rapidly develop and test out potential solutions. Key engineers spoke of the major breakthroughs that followed extended periods of "sitting together". Cancelling vacations to be present at critical points in the process was considered to be critically important to engineers involved in the project. Presence was also cited by the team's project manager as a way to see problems arise more quickly, thus paradoxically it would appear that presence may become more necessary as parallel processing and work task

complexity increase. The importance of physical embodiment in human interactions and processes has been highlighted as a means to avoid excessive abstraction and alienation (Hayles, 1999).

It has been claimed that co-presence provides the conditions for social integration, that “to turn one’s back on another while the other is speaking is in most (perhaps all?) societies a gesture of indifference or contempt” (Giddens, 1984:67). The members of the Mindstorms team were co-present when they gathered physically together for “time-outs”, allowing them to conduct mutually reflective monitoring, and develop context in a very intimate and integral fashion, to such processes of monitoring (Goffman, 1963).

In multinational teams, co-presence is particularly challenging, as the number of people who can participate in face-to-face encounters is generally limited. “The study of interaction in circumstances of co-presence is one basic component of the ‘bracketing’ of time-space that is both condition and outcome of human social association” (Giddens, 1984: 36). The close and regular contact that Sinclair tried to develop with his team members could be exasperating for all parties concerned, although it appeared to lead to an environment in which team members received regular feedback on their work, and appeared to feel their contribution mattered. This feedback would rapidly lead to the generation of new ideas, in a beneficial process of idea generation and implementation. “What from the angle of the fleeting moment might appear brief and trivial interchanges take on much more substance when seen as inherent in the iterative nature of social life” (Giddens, 1984: 72). Such activities were particularly crucial in an environment when the team was conceiving concepts and implementing *at the same time*.

A benefit of greater presence among team members is the increased possibility of beneficial co-evolutionary cycles of knowledge development. The biological notion of co-evolution has been developed in the complex adaptive systems literature as a way of understanding how evolutionary change might occur in nature. Co-evolution describes the reciprocal process by which one system adapts to changes occurring to other systems, which then cycle back and

provoke changes in the first system, and so on in a continuous cycle. Co-evolution means that instead of adapting to separate and distinct environments, agents are influenced by *and influence* their environments. A co-evolutionary struggle can ensue between "predator" and "prey" species, in which the former develops a slightly better predation method that is subsequently countered by a new protection innovation by the latter, and so on. Co-evolution is a powerful metaphor for us to manage our relationships. Co-evolutionary relationships generally provide long-term sustainability benefits for the co-evolving agents (Capra, 1996).

The notion of presence also appears to be a critical element in the generation of collective mind. The examples of collective mind observed in practice (cf. Weick and Roberts, 1993; Dougherty, 1998) appear to occur in environments with a high degree of physical proximity. In order to begin to develop the characteristics of a group mind, it would appear that the processes of representation, contribution and subordination are facilitated by regular contact.

Proposition #2: Because it facilitates communication and shared sense making, face-to-face interaction may enhance the ability of team members to adapt to and shape their environments in the face of critical incidents.

3. In the face of uncertainty, follow simple guiding principles

Although their environment was highly uncertain, and at no time did the team have all the possible information available with which to make decisions, it did take significant actions in real time. We observed that the team appeared to be guided in dealing with these critical incidents by some explicit and implicit simple guiding principles. The team was able to develop these principles because it had developed a good working knowledge of its identity, gained by members spending considerable in each other's presence, during which they were able to talk these principles through. The principles, in practice, seemed to function more as heuristics than as specific rules, as they guided behaviour while allowing for the emergence of entirely new phenomena.

We list below the principles we observed that were used by the Mindstorms team in responding to critical incidents:

a) “Stay in orbit”: the use of this metaphor by all team members—as well as the parent company--enabled the team to make sense of its relationship with LEGO: linked by an invisible yet powerful gravitational force. This principle came into play when the team was developing a common public relations statement with the parent company, while striving to maintain its own identity. It also helped the team better make sense of how it could draw on the well known LEGO name while not having to adopt the parent company’s operating practices.

b) “Parallel process”: 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. In this way, it reflected the constantly changing business environment it was facing. This principle came into play when the team worked to develop the hardware and software for the product simultaneously, a style of working that would never have occurred in the parent company.

c) “Be a real partner”: the team did not feel the need to assume a dominant position with their partners, which allowed it to partner with a wider variety of both large and fledgling partners. Working with partners in this way is a critically important starting point for building a real network. Even beyond the completion of the product, the team knew that sales could be boosted if they could create a network of customers, which in turn could be facilitated by creating a large network of partners.

d) “Carpe diem”: the team was action oriented at all times. By eschewing traditional planning processes, the team was able to make decisions more quickly than its parent company. Members of the team would proactively take initiatives in their own domains, including establishing new partnerships and dealing with existing ones, rather than waiting for approval from the team leader.

The idea of managing based on guiding principles rather than rules has been explored to some extent in the complex adaptive systems literature. Eisenhardt and Sull (2001) identify five types of "rules" that managers operating in complex environments can use in order to seize opportunities in a flexible, yet disciplined manner. However, the LEGO Mindstorms team did not appear to establish clearly definable, generic, and narrowly specific rules as such, rather its team members developed more general yet simple principles that appeared to lead to meaningful and effective responses. In this sense, the Mindstorms principles more closely resembled inferential heuristics (Kahneman and Tversky, 1973), rules of thumb we all use to make decisions in our daily lives. Heuristics are critically important in complex environments in which it is impossible to know everything that is going on all the time, and in which individuals cannot make optimal decisions alone. Team members that develop meaningful heuristics to guide themselves in making the many important decisions they have to make each day will be able to guide behaviour more dynamically and robustly than through use of a series of static rules. It may also be that the coherent action required to develop a robust collective mind can be facilitated by the use of guiding principles.

Proposition #3: Because they allow for many potential actions within a boundary of values, a shared set of guiding principles help team members to take coherent actions that enable them to adapt to and shape their environments.

Finding Coherence in LEGO Mindstorms

Weaving together our three propositions is the little-understood yet important notion of *coherence*. Coherence describes the concept of "holding together"…the glue that allows the manager and organization to reassert identity in the face of the continuous change demanded by co-evolutionary market forces (Lissack and Roos, 2001). Coherence is a vital element in sensemaking…fitting something puzzling into a coherent pattern of mental representations that include concepts, beliefs, goals and actions (Thagard, 2000).

In its reaction to each critical incident, the Mindstorms team undertook actions that appeared to improve its coherence and reduce the opposing pressure of fragmentation. In knowing more about its changing self, the team implicitly recognized that if the self is fragmented and decentred, then coherence can only exists as a mythic striving or 'desire', and not as common (everyday) experience (Letiche and Lissack, 2001). In being more present, the team may have understood that long-term coherence must be evoked, coaxed into existence from a convergence of interactions and sense making (Lissack and Roos, 2001). In developing a shared set of guiding principles, the team engaged in a social process to develop coherent ways of interacting with the outside world, enabling it to better handle surprises "on the fly". Although neither the theoretical construct of "collective mind" nor "hot groups" deals with coherence directly, we would suggest that coherence helps explain how both phenemena develop and persist in the face of critical incidents.

Conclusions

We are still some way from understanding what makes certain self-managed teams perform so much better than others in complex and surprising environments. It would appear that attempting to develop isolated correlations between objective variables such as team size or diversity and performance do not fully explain how some teams develop the ability to act as a "collective mind", or take on the characteristics of a "hot group".

In this paper we have proposed three interrelated propositions based on our study of how one particular team operated under difficult situations. The paper contributes to the research into self-managed teams by a) presenting an in-depth, empirical examination how one such team operated in practice, and b) examining this team's response to critical incidents. Our overall finding is that in the face of new and surprising situations, teams should work to improve their coherence by ensuring they have a shared sense of who they are, meeting face-to-face regularly, and acting according to already understood and agreed guiding principles. We suggest that these activities contribute to a team's ability to act quickly and effectively in complex environments.

Our propositions also raise questions for further research. In the face of uncertainty, what factors contribute most to the development of a shared sense of identity in a team? What is an appropriate balance between face-to-face and other forms of communication in such a team? How should simple principles be generated, and how do they change? We believe that further study in this area would benefit from more context-rich, in-depth study of how team coherence develops and is sustained over time.

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