The Role of Mental Models in Sustaining Innovative Teams

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ABSTRACT

This paper considers two cases (developed via observation and interviews), exploring the critical role of mental models in the success of innovative teams. The first case demonstrates that mental models in a multidisciplinary team can provide opportunity for a shared generation of knowledge for process innovation while open to external influence. The models enable analysis of context ‘now’ in an environment pervaded by uncertainty, continuous change and the need to make meaning of events for participants. This is accomplished as team members focus on why the team matters to those served by the team. The second case analyses a team in a different environment, where there are strongly shared mental models that prevent the team from constructing an accurate picture of their present by closing out external influences and pre-selecting desired knowledge. The paper concludes that mental models providing a sharing framework without closing out networks and systems that sustain them can foster and support innovation. However, the critical success factor is the ability of the mental models in use to enable an accurate analysis of the real time context of their application, so that ‘new’ is a synthesis based in the needs and circumstances of ‘now’. This is vital for innovation, thus managing team openness becomes a priority.

Introduction

Knowledge has been cited for some time as a major source of competitive advantage (de Geus, 1997; Drucker, 1964). More recently, the focus has been upon using knowledge to promote and support innovation within both teams and companies (Newell et al., 2002). According to London Innovation (2003) ‘Innovation is the successful exploitation of new ideas and is a vital ingredient for competitiveness, productivity and social gain within businesses and organisations’. This definition is important, as it indicates that not only must there be a creation of new knowledge, but that such knowledge must be shared and implemented in some way. Innovation is increasingly discussed as one of the desired outputs of knowledge, whilst the need to manage workers in order to develop the learning needed to promote knowledge and innovation is also identified (Swan et al., 2002). The argument is that, by managing the learning and knowledge creation processes carefully and developing an innovative culture, maximum innovation can be achieved. This indicates that the development of knowledge will be vital for the success of innovative teams. This paper will explore one aspect of knowledge development, that of the sharing and development of new ideas. The role of mental models in knowledge development will be explored, in order to show how the type and strength of the mental models held by the team will be a strong contributor to the team’s success in general and to innovation in particular. Two teams will be investigated, one successful and one unsuccessful, in order to analyse what is needed for mental models to be useful, rather than inhibiting, to the innovation process.
Methodology
This paper is based upon in-depth case studies undertaken upon two teams. The first case is of a multidisciplinary team in palliative care. This team is, typically, diverse in its makeup, containing disciplines representing medicine, nursing, social work, physiotherapy, spiritual care and grief counselling. Patients and patient-based carers also become members of the team. The case was chosen because of its history of successful, ongoing innovation, affecting the design and implementation of care. The second case analyses a team that was involved in developing, launching and running a new part of a business. It began as an integrated team within the company, but was then relocated to another building about 5 miles away. This team was chosen because it was an unsuccessful subset of a previously successful company. The new project it was designed to implement began as a radical innovation for the company, but failed very badly. Semi-structured interviews and observations were undertaken in both organisations and the resulting qualitative data was analysed for themes and ideas. The need for in depth study was identified, because of the exploratory and explanatory nature of the research in both cases, seeking to explain phenomena and develop an understanding of underlying reasons. In the second case, there was also an intention to build new theory as a result of the analysis. In both cases, teams were interviewed both individually and in groups in order to facilitate observation of the interaction between team members during explanations, providing as rich a set of descriptions as possible.

Innovation, Knowledge And Mental Models
Although the focus of innovation is, historically, economic (Nyström, 1980; Scherer, 1984), the source is social (Zaltman et al., 1973; Burns and Stalker, 1979). Processes of socialisation are noted as sources of knowledge (Nonaka and Kono, 1998), with socially and contextually produced knowledge being a source of innovation (Swan et al., 1999). Zaltman et al. (1973, 14) state that, “the distinguishing characteristic of an innovation is that instead of being an external object, it is the perception of a social unit that decides its newness”, before offering a definition of innovation as “...any idea, practice, or product that is perceived as new by the potential unit of adoption.” (Zaltman et al., 1973, 50). This concept of collective perception links innovation, knowledge and mental models in teams. Nonaka and Konno (1998) describe socially based knowledge generation and note that participation in a social situation defines what is knowledge and what is information. Knowledge is described as useful only at a specific time and place if it is to be of value. Knowledge that is separated from its situation becomes information, to be communicated between situations.

Mental models are a means by which organisations and individuals create and share meaning, thereby enabling a common understanding and the development of knowledge (Hill and Levenhagen, 1995; Flood, 1999; Pruzan, 2001). Shared mental models, where there is a common understanding by the individuals within an organisation, provide frameworks of value and belief systems which act as the basis for analysis of any new ideas, concepts, policies and cultural developments being considered by a team (Caldwell et al., 2002; Swaab et al., 2002). It is argued that shared mental models have an advantage for a group of individuals, as they provide both an element of predictability which facilitates communication (Wetzel and Buch, 2000; Dickson et al., 2001), and a link between collectives and individuals, thus acting as a context for the interpretation and understanding of new information (Doyle Conner et al., 1994; Dixon, 1997). Such shared understandings support learning and act as a framework for all new knowledge development. Shared mental models will, therefore, be of great importance
as they provide the structure which will affect the scope, the type and the acceptance of information that can be assimilated and interpreted by the team, thereby acting as the delimiters of new knowledge within and between teams. Why this is so can be understood when analysing Figure 1.

**Figure 1: Team Mental Model Development** (Lee-Kelley and Blackman, 2004)

For any new learning to occur, individuals need to be aware of any stimulus generating a perception of difference between mental models (Klimecki and Lassleben, 1999). This process is demonstrated in Figure 1 and it can be seen that new information will only be addressed in any meaningful way if a difference between the currently held mental model and the newly perceived apparent reality occurs. Once an individual perceives a difference, he/she will rationalise it and, if accepted, this new stimulus will be internalised and the individual mental model will be adjusted, reflecting the new information and developing it into knowledge. At this stage the individual shares, through the process of team communication, his/her new understanding, leading to a construction of new knowledge. As a consequence of the communication, some of the differences can be rationalised and assimilated into the collective mental model. This adjusted team mental model now acts as the framework for mutual reference and new knowledge development. If this new mental model supports innovative knowledge development then the team can be creative. However, if, for any reason, the mental model does not support innovative knowledge development, it is likely that the team will not achieve innovation in its outputs. What can also be seen here is that the perceived difference may be derived from differences between the mental models of individuals within a team, which will in themselves act as triggers for considering and discussing information. For example, where individuals have differing understandings of the same event, discussions about the event may trigger the process in Figure 1 and act as a communicating medium to make sense of the variations in information apparently present.

What is of great significance in the paper is that figure 1 assumes an open process of information acquisition and knowledge development, whereby all new differences are both recognised and accepted by the team members. However, this is very unlikely, since either the individuals or the team may reject certain ideas. This view of a mental model as a framework for new knowledge means that it could, potentially, act as a closing mechanism. Blackman (2001) and Coopey (1996) have demonstrated that, through dominant logic and coalitions, new knowledge creation can become self-referential in nature, leading to only those ideas related to the current mental model being acceptable to the system for consideration. The stronger the mental model, the greater the influence it has upon the state of openness of the system. In extreme cases, the flow of knowledge acquisition can be completely turned around with only ideas...
which have been actively sought out by members of the system being recognised and encouraged (Blackman, 2001). Should this occur, there would be serious changes to the flows seen in Figure 1. What can be inferred from this is that, once team mental models are in place, the stronger they are, the more likely it is that they will become self-referential and close down the system, thus becoming even stronger. The system becomes increasingly predictable, ultimately reducing opportunities for flexibility and adaptability to new ideas (Hill and Levenhagen, 1995). If the shared frameworks themselves become the problem then the ensuing, reduced, levels of flexibility will shape collective learning and any effective development of knowledge, not only within teams but also throughout the organisation as a whole. The two case studies were analysed in order to establish what strong mental models were in place and to determine what impact these mental models had upon the knowledge development of the teams. Such an analysis would, it was postulated, enable the researchers to identify the role of mental models in the development and support of innovative practices in teams.

**Case 1: Mental Models In Multidisciplinary Palliative Care Teams**

The contemporary palliative care environment is one of "active and compassionate care primarily directed toward improving the quality of life for people who are dying, and toward supporting patients and families as they incur multiple losses" (McDonald and Krauser, 1996, 2). This environment is attended by a number of professions including nursing, medicine, pharmacology, physiotherapy, occupational therapy, social work, pastoral care, grief counselling and administration. This is a manifold environment where people are the centre, not diseases, where care results from the understanding of the causes of suffering (Barbato, 1999) and where multi-profession teams work collegiately, so that the primary issue becomes and remains patient comfort (Meyers, 1997). The quality of life for people at the end of their lives is an issue of relief of distress, whether the cause is physical, emotional or spiritual; known or unknown (McDonald and Krauser, 1996; Witt Sherman, 1999). Uncertainty pervades the palliative care environment. The trajectory of a disease that brings a patient and patient based carers to palliative care is uncertain (Henkelman and Dalinis, 1998a; Rose, 1999). Symptoms, for example pain, are not necessarily linked to obvious causes (Lewis et al., 1997). Reactions of patients and patient based carers to the end of life process are considered variable (Henkelman and Dalinis, 1998a; Pierce, 1999). Membership of the group of patient-based carers can change during the end of life process. The reactions of palliative care professionals to the situations that they encounter during the end of life process of those in their care can vary (McDonald and Krauser, 1996; Henkelman and Dalinis, 1998a). The required level of extension of the palliative care service to individuals and groups who accompany the patient is uncertain (Lewis et al., 1997). In addition, the range of palliation requirements which occur, and are driven, at the conscious and unconscious levels and the depth of experience at each level varies from patient to patient (Kearney, 1992).

According to Lazarus and Folkman (1984) uncertainty, as it is considered in the social sciences, can be said to fall into two categories, event-based and temporally-based; uncertainty about what will happen and what the results will be and uncertainty about when it will happen and how long it will take. Both types of uncertainty are capable of generating confusion and helplessness, particularly in cases of physical illness and disability. Uncertainty is also capable of immobilising anticipatory coping and, therefore, the necessary decision making for dealing with the uncertainty being faced. The persistence of uncertainty is noted in the constant changing of patients’ situations,
each of which is considered unique and requires constant re-assessment. Changes in a patient’s end of life situation can occur as a result of a change in any of the elements of the patient’s life (Henkelman and Dalinis, 1998b). Changes occur at multiple levels, sometimes in parallel, sometimes without obvious causes, sometimes without notice, sometimes without clear causal linkages between change and effect, sometimes consciously on the part of the patient or patient-based carers and sometimes not. This highlights the ability of a patient’s situation to mediate that patient’s care.

Locating the majority source of uncertainty with the patient means also that the patient becomes the major informant of situational change (Henkelman and Dalinis, 1998b). This makes palliative care professionals dependent on each patient’s ability to explain what is changing, when and at what level and requires that the professionals be able to enable and understand that explanation. The use of multidisciplinary teams is a response to the levels of uncertainty noted above and to the range of palliation requirements that could be necessary for any given patient (McDonald and Krauser, 1996; Meyers, 1997). While the use of a multidisciplinary care delivery model is not unusual in healthcare generally and the use of multidisciplinary or multi-functional teams is not unusual outside of healthcare, the dynamics of uncertainty in the palliative care environment create a level of complexity in team operation. The usefulness of multidisciplinary operations in palliative care is the opportunity it provides for teams and members to mobilise and learn from each other’s skills and experiences in patient care (Witt Sherman, 1999).

A key shared mental model in the Case 1 team is the need to deal with persistent uncertainty, knowing that uncertainty in patients’ situations means uncertainty in efforts to provide care and a preparedness to change care management as necessary. Existence of this commonly held mental model is evidenced at interview, with comments from different disciplines, with regard to patients. “These people, each day things change as their illness goes onwards and therefore they always have changing needs.” [Doctor] Another doctor, relating the process of first meeting patients at admission to the palliative care organisation, noted the following considerations; “... are they the sort of person that can cope with what’s happening to them? Do they need more support than another person? Are they an outgoing person or a withdrawn person? ...... You try and build rapport, to try and get information. It needs honesty, it needs trust and therefore that’s what we build. Of course you pick up the other things, is this person going to be a good patient? Is it going to be easy to look after them or are they going to need prompting? Will we need to recheck again and again, ‘are you sure you’ve got no pain?’ ...... Some people will be straight out and tell you everything while others will be reticent. You need to pick that up, because that will change your management from one patient to another.” A social worker noted. ”Their adjustment to their illness and how they perceive they are, and the whole process of it. And what, the kind of things they talk about, whether they talk about death and dying or whether they’re still talking about treatment. What kind of phase they’re in emotionally and psychologically.” Each patient is different and care requires different management from patient to patient.

This overriding mental model drives several others to enable care delivery to operate successfully; respect between the disciplines for the skills contained within them; informal communications which are frequently more relevant, temporally, than formal communications; and all members of disciplines observe and report on behalf of other disciplines.
Respect was an issue that was related to the credibility of information exchanged between the disciplines. This was particularly in evidence when team members were discussing the use of informal communications to report observed changes, or impending changes, in patient situations without waiting for formal multidisciplinary team meetings. Respect was referred to as an enabler of inter-team relationships, as in the following examples: “If something’s not communicated then that’s usually where our problems begin. But, I mean, one of the good things about this team is positive atmosphere and the relationships. You know, there’s little communication breakdowns here and there once in a while, from my experience, and, but it’s not a great thing, you get over it and move on. I think ‘cause there is that respect, you know, it’s not a personal affront to anybody, it’s just that you recognise that it’s just a communication breakdown” [Physiotherapist]. “I’m new to the team here and I think that more than anywhere else I’ve been before that everyone respects each other a lot more, and each other’s opinion. Like, quite often in regard to a patient someone will come up and say ‘what do you think about this patient?’, or you’ve gone, you know, ‘I’m having trouble with this person, what do you think is the best way to approach it?’. And I think there’s a lot more respect than there is in say other areas of the health system” [Doctor].

Informal communications are used constantly, as referred to in the quotes from the interview above. However, particular references were made to the value of communicating informally: “I think communication’s easier here. More readily available, we don’t have to chase people around the hospital and find them, to communicate with them” [Clinical Nurse Educator]. “Yeah, I mean formally it’s in the nursing and medical admission that you ask the patient what their expectation of the admission is. But I think, probably even in an ad hoc manner, the allied health staff would also do that. You know, you gauge from the patient, and very much it’s patient focused and patient led, what the care should be. Very much so.” [Clinical Nurse Educator] The temporality of informal communications was evidenced in the following statement, “There’d not be a day when you didn’t talk to other members of the multidisciplinary team about most patients. You’d be saying, what’s happening with this patient? You know, this is something that’s come up as a highlighter for me, you know, and we discuss possible solutions or ideas around issues. You know, no one person really makes decisions on, you know, their bit of information that they’ve found and this is the solution for it. We all kind of rely on each other for opinions and, you know, ideas of how to then move forward with the information that we’ve all gathered individually.” [Social Worker]

With regard to all members of disciplines represented in the team observing on behalf of the team, the following is an interesting example from a nurse; “Yeah, I mean I think there are no interdisciplinary boundaries, per se, here. I think nobody’s going to get annoyed if a physio comes to a doctor and says ‘this patient needs more pain relief’. Or if an occupational therapist comes to a social worker and says ‘this patient’s having problems with their family’. You know, it’s that interlinking and the blending of the roles that hopefully creates a better care model for the patient.” This statement was made with the spoken agreement of the team. These mental models appear to set and maintain an environment for the open exchange of information that is capable of generating collectively held knowledge. This seems to encourage and enable contributory membership of the team.
According to Mintzberg (1989, 199), “Sophisticated innovation requires a very different configuration, one that is able to fuse experts drawn from different disciplines into smoothly functioning ad hoc project teams”. Innovative organisations are found in complex, relatively dynamic environments where the requirement is for flexibility in structure so that different forms of expertise can be drawn together quickly in order to address problems and situations directly. These organisations employ people with high levels of knowledge and skills and use them as a foundation for the ongoing development of knowledge and skills relevant to the work. This use of multidisciplinary teams in the complex, dynamic environment of palliative care, where it is common to quickly deploy mixed groups of professionals in response to particular situations, is reminiscent of Mintzberg’s (1989) description of an innovative organisation. Crossan et al. (1993) link diversity in teams to individual and collective learning in organisations, where groups need shared meanings to be generated from joint efforts. The basis for the generation of learning as described by these authors, is the diversity of schemas, the belief systems that guide actions, available within the team for use in interpreting the environment and integrating individual interpretations. Crossan et al. (1993) note that an individual’s potential for interpretation is founded on the complexity of the concepts and relationships that generated the individual’s schemas. Higher levels of complexity offer higher potential for interpretation.

Team members in Case 1 share strongly held mental models. The first of these is that uncertainty accompanies people in their end of life process in palliative care and all efforts to deliver care must recognise this. Uncertainty here does not drive a search for certainty, simplicity or predictability; it drives a constant and collective search to understand what is happening ‘now’ in the patient’s situation. To this end, respect is offered and received as an enabler of credible contribution, leading to the sharing of ideas and information, within the team, across teams and within the disciplines, that are contextually based and aimed at contemporaneous outputs. Overlying all of this is a shared understanding about what palliative care is about, what it encompasses and how it should be approached. The word ‘approached’ is important here as there is not a shared understanding of how each situation is to be undertaken, the outputs may change each time to suit the situation. What is shared is the focus upon an output that will suit each specific patient; team members focus on why the team matters to those served by them and make their decisions based upon this concept. Almost as important as the shared mental model of what is palliative care, is a strongly shared mental model of what it is not; it is not about illness or about symptoms, it is about people. The importance of the mental models being focused upon the outputs of care, not the processual inputs, is vital here as it provides the team with opportunities for shared generation of knowledge for process innovation, while remaining open to external influences. The models enable an analysis of the current context in an environment pervaded by uncertainty, continuous change and the need to make sense of events for participants.

**Case 2: Mental Models At A Flight Brokerage**

Historically, the company where Case 2 is located had been run as an aircraft seat brokerage. The company worked in three capacities; operating call centres for airlines enabling their reservations and bookings systems; brokering airline seats on flights that were not selling to other clients; sourcing tickets for groups, etc. Case 2 had a history of innovative behaviour, frequently developing new products within the framework of its industry. Theirs was a relatively stable business (after a history of some problems) and
it was decided to develop a new dimension to the business; chartering an aircraft and developing their own airline. This was an expensive, risky and very complex venture that, if it succeeded, would lead to enormous company growth, but failure could bring the whole company down. To undertake such a project fitted with the profile of the company, in that there had been a history of taking considerable risks with highly entrepreneurial and innovative aspects to them (Fuller et al., 2001). A team was set up for this developmental project and an aircraft was chartered for 18 months. However, the venture was unsuccessful and the airline had to close after 12 months. An analysis of the mental models in place within the company at the time explains some aspects of the failure, giving some insights into the knowledge development problems encountered by the team.

Analysis revealed that there were several very strongly shared mental models held within the company. The first mental model in place was a ‘Fantasy’ view of the aviation industry at the time. With hindsight, the directors felt that their picture of the industry at the time was totally at odds with the reality. However, this model was so strong that it overrode compelling evidence from a respected source, a previous Financial Director with the company, that the project would not work. The idea of running an airline had always been very attractive, so the group wanted to believe it was the correct time to do it: “I thought it was a nice idea we’d always dreamt about the idea of having our own aeroplane since Paul started the company and it seemed that this was the realisation of that dream to some extent” [Company Director]. This led to a rejection of ideas that did not fit this fantasy view. They felt they could reject these ideas, as they had expertise above those commenting upon their industry. A similar reaction was noted by Marks and Spencer who rejected analysts’ comments prior to their serious problems in 1999 (Mellahi et al., 2001). The second, even more strongly shared mental model was that all charter airlines make money in the summer, providing that the aircraft are full: “the idea was that, let's say whatever you made in summer one you might lose in winter one, but then you've got summer two, so as long as you always come out on a summer at the end of your commitment on your whatever it is you're buying, you should be ahead” [Project Manager]. The aircraft charter had been contracted for two summers and one winter and, therefore, the project had to work. It was described as ‘Everyone knows that two summers and a winter has to make money’. This absolute certainty led to evidence of monetary losses being ignored and refuted since they had to be making money because ‘Everyone knows ...’. A third mental model was present that had a history from previous problems within the company history; ‘Betting the Company’ worked. The founding directors confirmed that one of their basic rules was not to bet the company. However, whenever they had done so there was a history of its being a success story. This had tended to encourage further innovative behaviours, both products brought to the market and methods of implementing the products, via encouraging an entrepreneurial culture within the company. Employees were encouraged to run with new ideas; enabling the Project Manager to manage the new project as he saw fit was part and parcel of the company ethos. Thus, the picture held was one of breaking the rule successfully, so to do it again did not seem such a gamble; especially as the plan ‘could not fail’. Despite its being stated by all team members that they thought the risk was very high, the history of betting the company enabled them to reject differences that signalled that this time it might not work.
The team was further able to ignore the financial evidence of failure as it developed because of two other mental models that were in place. The airline business has a very positive cash flow, as revenue is incoming at the time of ticket purchase and the majority of expenses occur later when the aircraft actually flies. As a result the company had never had so much money in the bank, leading to a belief that they had to be making money: “All they saw was this enormous amount of money in the bank and they were having great fun on treasury and doing all sorts of things” [Project Administrator]. Subsequently, the figures showed that the cash flow was substantial (which was unusual for a small company and was, consequently, misleading) but the profit and loss was, undoubtedly, a loss. At the same time as having more money than ever, there was also prejudice regarding the accountant, who was seen as unreliable and over controlling. He was generally pessimistic and so was seen as rather a ‘wet blanket’. Moreover, he had a history of errors, which meant it was easy to doubt him. He did not have strong verbal skills and so tended to be bypassed in discussions. All members of the senior team assumed he was mistaken so that “When there were errors they were [the accountant] – everyone was rude to him for a while, condemning the man; aviation is quirky but he was right” [Director]. So strong was this view of the financial controller that one of the directors was given the task of “finding out where he has gone wrong”.

It was outlined earlier that the strength of the mental models is of importance here, as the stronger the model held, the more of a filtration device it could become, distorting the new ideas entering the system. It might have been expected that, as evidence emerged that challenged the mental models, the team would, unwillingly but inevitably, have accepted some of this new information and developed a new set of knowledge with which to frame the world. However, an important development occurred during the project. The team, which had previously been sharing space within a part of the company building, had been relocated to a building on their own. This led to a ‘them and us’ feeling between the team and the remainder of the company: “Strong boundary around the team increasing in strength rejecting any challenge. Got stronger as the project grew - resisted outsiders.” [Director]. Although the company mental models began to be amended, those of the team did not develop in the same way. The team mental models were amended to believe that ‘they’, the company, were wrong and out to get the team and that the team must defend itself and the company views. Thus, team mental models became still stronger and rejected any ideas that did not fit with team worldviews. During interviewing two years later, team members still believed that the project had made money and that ‘they’ (the directors) had misrepresented the figures in some way. As a result, it can be seen that too strongly shared mental models can prevent the team from constructing an accurate picture of the present by closing out external influences and selecting desired or acceptable knowledge only. The team had no realistic picture of the context and situation that they were in.

**Discussion**

What is of interest is why the different cases were not both successful as both had strongly shared mental models and only in case 2 does this appear to be a problem. The analysis needs to address whether the mental models are closing the system, or not and why this occurs in one case and not the other. It was stated earlier that an initial difference must be perceived to trigger the mental model change process for there to be learning and change. It became clear that in case 2, differences were being ignored and/or actively rejected, whereas in case 1 the mental models actively encouraged the
recognition and assimilation of differences. One difference between the cases was identified as the focus of the mental models and what was, in fact, shared and what was not. The mental models in case 1 were concerned with what the team was for, not about how they acted, whereas the mental models in case 2 considered the actual project, how it should be undertaken and the identity of the team, not as to who they were for others, but as to how they were seen by themselves. The focus of case 1’s mental models was upon understanding how to accommodate changes, whereas case 2 was about maintaining the accepted norms. Case 2 had become self-referential, whilst case 1 had not. The fundamental differences were that those in case 1 did not have to share beliefs about process, or even care, what they had to share was an identity of their patient and what mattered for the patient. In case 2 the team members were expected to share and believe all aspects of the project or they were no longer ‘accepted’. This lack of openness to challenge led to an increased closure to ideas and changes and, ultimately, led to the failure of the project. Again, the question has to be why was one so different from the other in the way the innovative team developed.

The commonalities in both cases are strongly held mental models, collective decision making and common goals in the teams. Apart from these commonalities, the second issue that seems to differentiate the cases is time. In case 1 the acknowledgment of pervading uncertainty and the concentration on the patient’s situation as the basis for care means that ‘now’ is the focus; contextually based contemporaneous outputs are necessary. Thus, knowledge is accepted as being partial, incomplete and continually evolving. This leads to an openness of the system being maintained, as change to the mental models is an accepted part of the team behaviours, in order to continually update the processes in place. In case 2, time played a different role, actually a number of roles. Firstly, the temporal difference between revenue raising and expenditures enabled a disoriented picture of cash flow to be created. Secondly, a relatively long period of time, 18 months, was set for the indication of success in the new venture. Thirdly, the company had survived over a period of time by breaking fundamental rules established at its beginning by directors, setting the pattern of success by defiance. This led to a different view of knowledge within the company; instead of being evolving it became more of a series of steps. In the case of the new project, this was a new step and the team froze into this perspective. Because the focus became about implementing the project itself, rather than about developing new ideas and evolving their view of the world, the closure set in and then got stronger.

There are important lessons to be learnt for innovation. That the system must remain open becomes a given; how this can be achieved by actively harnessing mental models in order to promote learning and knowledge becomes the important question. From the preliminary analysis above the aspects of knowledge and time have become of primary importance. Mental models not only create knowledge via the information processing systems, but they also create an understanding of what knowledge is. Thus, for there to be innovation the mental models must be developing a notion of knowledge as pragmatic and evolving. Knowledge development must be seen in terms of process and not in terms of facts or truths to be found. In case 1, the team is not seeking a right answer, it is seeking the appropriate answer for ‘now’. In case 2, it was believed there was a ‘right’ way and this was developed over time. There needs, therefore, to be an actual managed mental model of knowledge and its role. Such a conclusion stresses that the links between knowledge management debates and innovation are correct. However, most of the debates stress the need for new knowledge creation, with the systems that
are encouraged within companies being more likely to develop mental models as in case 2 rather than case 1, because the focus tends to be upon sharing the actual knowledge between individuals, rather than using different knowledge sets to develop a shared understanding of a situation within a context. Case 1 exemplifies how, despite all team members having different knowledge sets and not necessarily agreeing with the knowledge held by others, their goals can be achieved, as the focus is upon what is best for this patient at a particular time in a particular context, not upon a macro answer to all problems.

Conclusion
This paper argues that where mental models provide a sharing framework without closing out the networks and systems that sustain new knowledge development, they can foster and support innovation. However, the critical success factor is the ability of the mental models in use to enable an accurate analysis of the real time context of their application, so that ‘new’ is a synthesis based in the needs and circumstances of 'now'. This is vital for innovation, thus managing team openness becomes a priority, and this can be achieved via developing alternative perspectives of knowledge creation. The synthesis of knowledge needs to be considered as a dynamic process producing contextual relevance. Each person in a team will combine unique experiences, perspectives and requirements with a selection of available information to synthesis knowledge in a given context. Both concepts are well represented in the literature on situated cognition. The literature on innovation offers the concepts of socially based generation from something perceived as new to the innovators. This paper also argues that contemporaneous context is key. The case 1 team innovated successfully because they were able to focus on the ‘here and now’ and maintain the reality of the current period in their view. The case 2 team failed because their view had become fixed on a point in the future. The team then chose to avoid contemporaneous issues because, in their mental models, they were not relevant to that chosen future. Knowledge needs to be considered as a continuously changing set of understandings, that do not, in themselves have to be shared. Each person’s different knowledge can be used to create an understanding of the here and now at all times. Without this current context, stagnation is likely to develop and innovation will be suppressed.

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