Social Learning in the Australian Defence Force: A Pilot Study

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Abstract

A Pilot Study was conducted at Strike Reconnaissance Group (SRG), over a six-month period in 1998. The long-term aim of study is to understand the principles and mechanisms of *social learning* within the Australian Defence Force (ADF). Social learning is a term generally used to describe learning that is done in or by a group, or an organisation, or any other cultural cluster; and to distinguish it from learning that is purely individual. These principles will be used to guide the development of information systems that will support and facilitate the most successful organisational learning practices in Command and Control within the ADF.

The aims of the pilot study were: to test the hypothesis that there are effective social learning mechanisms at the tactical level; to see if it was feasible to observe, understand and document social learning processes, particularly in command and control situations; and to trial the use of ethnographic techniques for this purpose.

In all regards, the pilot study was successful. It was found that ethnographic techniques are eminently suitable for observing social learning mechanisms. Many such mechanisms were seen at SRG. This paper reports the outcome of the pilot study. Future work will aim to extend the study into the strategic and operational areas of the ADF to develop information system and organisational architectures that will support and enhance social learning.

1. Introduction

Military organisations, with their dependence on posting cycles are reliant on successful staff training for their viability. Anecdotal evidence suggests however, that within the Australian military, especially in the strategic and operational levels, this training is not as successful as it could be. The Social Learning Architectures task is an attempt to circumvent this problem by understanding and eventually, modelling the successful social learning[1] patterns that underpin collaborative command and control work.

For this work, social learning is defined as:

- the procedures by which knowledge and practice are transmitted across posting cycles, across different work situations and across time, and
- the procedures that facilitate generative learning, that is, learning that enhances the ADF's ability to adjust to dynamic and unexpected situations and to react creatively to them.

The Social Learning Architectures task is a long term study that aims to address these issues by investigating social learning within a socio-technical framework. It will analyse how personnel involved in command and control environments learn to do their jobs. At the same time, it promises to provide insight into how individuals: use and pass on information, are affected when the work they are doing changes over time, and adapt to these changes.

It is envisioned that once the components, patterns and inter-relationships of this form of social learning are identified, understood and documented, the resulting architecture can support both individual and enterprise learning. It is also hoped that such an understanding will result in systems that truly support the way users work.

An increasingly common theme within information systems research is that, for successful adoption of these systems, a focus on purely technical issues is insufficient to guarantee success [Davenport et al., 1992; Davenport, 1994; DeLone & McLean, 1992; Martin et al., 1991; Laudon & Laudon, 1994; Sauer, 1993]. It is necessary to broaden the focus from the technical to the socio-technical, where people form an integral part of systems, and where issues such as training and culture (both human and organisational) are given more prominence.

A Pilot Study was conducted over a six-month period in 1998. Its purpose was twofold: to see if it was feasible to observe, understand and document social learning processes, particularly in

[1] While the term social learning has been used occasionally by the education and psychology disciplines, the term has been adapted and redefined for this research. The definition used is based on theories presented by Jean Lave, Etienne Wenger and the organisational learning literature.

command and control situations; and to trail the use of ethnographic techniques for this purpose. The setting chosen was a Wing Command of the Royal Australian Air Force Strike Reconnaissance Group (SRG). The primary mission of SRG is to conduct Strike missions by aircrew flying F111 aircraft. The study period included both peacetime training and deployment on an exercise.

The study used the ethnographic techniques of observation and directed interview, which this paper argues are well suited to the study of socio-technical systems. The use of these techniques in studying military headquarters is not new; they have been used within DSTO for many years [Clarke et al., 1992; Chin et al., 1994]. The difference was in the study focus. Rather than investigating a single issue, the researchers immersed themselves in the situation at SRG, in an attempt to obtain a deep contextual view. From this immersion, the ethnographic researcher hopes to gradually see and understand the key influences within the setting being studied [Jordan, 1991].

SRG successfully trains pilots and navigators to fly aircraft. Members of the aircrew community also learn the skills needed to help maintain the aircraft on deployment, and to participate in the running of the squadron and the Wing and Group Headquarters. As well as formal training, there was strong evidence for a substantial number of other mechanisms supporting social learning. These mechanisms included osmosis, mentoring, peer review, development trajectories and legitimate peripheral participation [Wenger, 1998; Hutchins, 1996].

Issues of individual expertise and their currency, legitimate peripheral participation, career paths and experience, team work, shared understanding, shared vision, the changing work environment, tools, artefacts, representations, power and authority all appear to be components of the social learning architecture in a common and control organisation. It is not yet clear what the relative importance of each of these elements is but it is envisioned that further study will make this clearer. This paper will explore the ethnographic methodology where conclusions will be drawn about the methodology's validity. The threads of understanding derived from the Pilot Study range from observations of the detailed formal and informal learning processes used to propagate the communities of practice in the Pilot setting; through the links between different communities of SRG and the routines and attitudes that facilitate organisational learning; through to the broader social issues of power, discipline and surveillance, that impinge on the effectiveness of social learning in the organisation.

The paper concludes by reporting on some of the major observations. It is stated that one of the key elements in understanding workplace interactions which occur at SRG requires some insight into dimensions of power within the organisation. Understandings of power, it is argued, is integral to constructions of knowledge. Not unrelated to this is the concept of surveillance in the workplace where a subject's self surveillance helps to maintain and reproduce a strong core of discipline.

2. Context

In this section, the setting for the pilot study is described briefly. In addition, the context and background for the task is given in terms of the increasing awareness of the importance of social

and organisational factors in successful systems development; the socio-technical approach to requirements gathering; and the importance of social and organisational learning in successful, innovative organisations.

2.1 The Setting for the Pilot Study

The setting chosen for the study was 82Wing, a Wing Command of the Royal Australian Air Force Strike Reconnaissance Group. Five field trips were made over a six month period: four to the Wing Headquarters at the Strike Reconnaissance Group at Amberley Air Base in Queensland, and one to Darwin. In Darwin, personnel from 82Wing were joined by members of other Wing headquarters, to form the Headquarters for "Orange Air", to take the role of "the enemy" in the Pitch Black military exercise [Warne, 1999].

Most of the fieldwork was conducted at SRG's normal peacetime environment at Amberley Air Force base. Work at Amberley focuses on training, and maintaining capability. The 82 Wing Command includes two squadrons - 1 Squadron and 6 Squadron - each with their own Commanding Officer. The primary mission of SRG is to conduct strike missions. Strike missions are conducted by aircrew flying F111 aircraft. The strike aircrew consists of pilots and navigators, since flying an F111 requires one pilot and one navigator.

2.2 Social and Organisational Factors in Successful Systems Development

Researchers and practitioners have been concerned about improving the successful development and implementation of computer systems projects for almost three decades. As the industry evolves, the search for the factors influencing success and failure has intensified. While the definitions and the exact rate of success may remain debatable, no-one in the industry would deny that whatever the figures are, too many delivered information systems fail to meet users' expectations and too many delivered systems are "shelved" or "bypassed" by clients and not used optimally.

Technical issues are obviously very relevant and important; and technical deficiencies are often the reasons for the sub-optimal use of systems. However, in the past decade, there has been an increasing emphasis, particularly in the information systems literature, on investigating the social and organisational factors that may help the industry build more successful systems - the alignment with organisational goals and the human issues in the development process [Ahituv et al., 1994; Butterfield & Pendegraft, 1996; Davenport et al., 1992; Davenport, 1994; DeLone & McLean, 1992; Martin et al., 1991; Laudon & Laudon, 1994; Newman & Robey, 1992; Sauer, 1993].

The same issues are also relevant to the success and failure of both extant and future command and control systems. A focus on purely technical issues ignores the importance of the human 'components' of these systems. Successful development of command and control systems necessitates a sound understanding of organisational culture, human social interactions, communication and relationships. The study of systems that incorporate both the technical and social aspects of system development is termed the study of socio-technical systems.

2.3 A Different Perspective on Human Knowledge

An assumption that underlies the socio-technical approach is that human knowledge is socially and culturally constructed. It is easy to think of examples to support this perspective. A topical example is the idea of people, flying to a remote island of the world, to be amongst the first people to see the dawn of the new millennium. This notion implies a calendar system that numbers years, a society that places some premium on a year whose number is a multiple of 1000, a society whose citizens can travel long distances quickly and conveniently, and a society that values novelty. The links between culture and technology appear in many places. Many Japanese companies, whose computers use the emperor system to record years, will not experience the Millennium Bug problem [de Jager, 1999].

A consequence of adopting this different perspective is that knowledge can no longer viewed as a property of an individual. It then becomes imperative 'to investigate the ways in which people in the workplace "co-construct" knowledge [Jordan, 1993]. A further outcome of this perspective is that learning can be seen to be partly a process of enculturation.

2.4 Why Select an Ethnographic[2] Approach?

Studies which identify the need to consider context in tend to support qualitative techniques where context is treated as the socially constructed reality of groups of social agents and the key analytic task is to expose the layers of meaning in the social process. Since context is crucial to qualitative observations and analyses, techniques that effectively explore contextual webs of meaning are important. The main body of techniques that fit this criteria fall under the domain of ethnographic approaches [Harvey & Myers, 1995]. Given the exploratory nature of the Pilot Study research, the importance of the context and the need to understand the social process of learning, ethnography appeared to be the most logical and viable form of methodology to adopt.

3. Issues of Applying Ethnographic Methods in a Military Environment with Multidisciplinary Teams

This work was done by a multidisciplinary team. Initially, only one member of the team had expertise in applying ethnographic techniques. This section explores several important issues that the team experienced and has needed to address.

3.1 Negotiation

Over the six months of fieldwork at SRG, on-going processes of negotiations took place between team members, particularly in terms of what does and does not constitute ethnography. Team

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[2] Ethnography is not a new research methodology; it has been standard practice in anthropology for decades. However, it is now becoming more widely and successfully used in information systems research (Myers, 1999). Ethnographers try to immerse themselves in the situation they are researching, in an attempt to obtain a deeply contextual view. From this immersion, the ethnographer is able to gradually see and understand the key concepts that influence the setting being studied. Ethnographers take on a learning and interpretive role, rather than attempting to test hypotheses. The primary analytic task is to uncover and explicate the way in which people manage their day-to-day situations [Miles & Huberman, 1994].

members had to leverage their individual expertise and experience to negotiate across the different disciplines present in the team, and shape the kind of ethnography, which eventually took place.

An important area for negotiation centred around the need to have some shared understanding on what were to become the key research issues for this Pilot Study. Most team members entered the SRG environment knowing very little about the various tactical manoeuvres that aircrew must employ during various missions. Moreover, there was little shared knowledge around current weapons, or those which are presently being developed. One team member however, had been exposed to this world before and had some understanding of the work culture at SRG. Nonetheless, there were some disadvantages associated with this, for whilst this particular team member had a great deal of knowledge about the SRG world from previous research he had done, he was in some sense seeing things from the past, and focused on understandings that were no longer applicable. Nevertheless without this initial input, the project would not have progressed as quickly as it did, as an historical understanding of SRG enhanced the teams understanding of current workplace practices. Moreover, without this member's prior knowledge, the team would have needed to undertake many more field trips before they could have achieved the emic perspective which is desirable within ethnographic research [Agar, 1980]. Overall this prior knowledge and understanding of the SRG world enhanced the team's ability to put many things into perspective.

Many questions were raised regarding the details of 'doing' ethnography within a military setting. The questions asked included: how 'pure' can this particular ethnographic work be, given the setting? How much of the fieldwork should consist of observations and how much time (if any) should be spent on interviewing key informants? Can the team really remain unobtrusive given that they themselves are not military personnel? How many researchers should there be in one setting at one time? The issues raised are important, particularly since the object of the pilot phase was to capture social learning processes in the SRG world whilst remaining unobtrusive. However, resolving these concerns was at times met with difficulty since the individual researcher's observations of the SRG world was directly linked to their various knowledge bases. There is a very detailed process involved in making sure that all team members capture what each other is observing. Thus, rather than insisting on one unitary picture, the study has benefited from the multiple stories and understandings which have emerged from the team.

3.2 Subject positioning

Most methodology textbooks celebrate the value of detachment. Whether in terms of the participant observer blending into the field; the interviewer abstaining from asking leading questions or careful drawing up of an interview schedule. There have been some recent challenges to this assumption urging researchers to understand their own subject positioning within the various research milieu in which they operate [Stanley and Wise, 1983; Smith, 1987; Zaharlick, 1992].

As members of a research team each individual must locate him / herself and take up as their own narratives of themselves whilst at the same time learn to be coherent members of other' narratives [Davies, 1993]. Thus, understanding the various subject positionings of team members in the

overall research is central in guiding the researchers into specific settings; and knowing where individuals can and can not go. The division of people into males and females is so fundamental in everyday talk and to basic understandings of identity that gender is generally understood as a fixture and a fact of the real world.

Women researchers working in a male dominated world, where there are no women aircrew, experienced the SRG world in a different way to their male counterparts. Ethnographers work in very close proximity with their informants, observing them as they work at their desks; throughout all the stages of the mission cycle; following aircrew back in the de-briefing room where mistakes and vulnerability are highlighted and contested. The way in which male members of the research team are positioned in this environment is very different to how women are positioned. More often than not, women researchers in male dominated settings are seen first as women and second as researchers whereas for the most part male researchers are seen as researchers, their gender often going unnoticed.

This is not to say that male researchers have an advantage over women researchers since understandings of appropriate masculinity in this setting can mean that men have to work much harder in eliciting conversation with male informants [Connell, 1995]. Civilian women can relatively easily initiate conversations with aircrew, whereas civilian men need to justify the basis for any conversation they start with informants.

The gender of the researcher in this setting also impacts on how much one can or cannot participate in the informal activities. Following aircrew to the mess for a drink after work is read differently according to gender. Women and men researchers are constrained somewhat by the rules and structures of the social world in which they are working and understandings of appropriate masculinity and appropriate femininity [Morgan, 1992]. To maintain one's subject status as researchers and members of a team, individuals need to constantly negotiate their 'femininity' or 'masculinity'. The processes through which the team members' subjectivities are constituted in this setting overlap with ways of speaking and behaving, as well as the relations and situations in which the various researchers found themselves.

3.3 Constraints

There were a number of constraints placed on the ethnographic aspects of the Pilot Study. Over the period the study took place the composition of the team changed significantly with all but one team member leaving the team either permanently or for a period of time. This was further exacerbated by the fact that the lead ethnographer was only available two days per week on contract.

3.4 Making the Invisible Visible

An interesting limitation of the methodology identified by the research team was the fact that, for routine work, social learning was often invisible. This essentially left the team with two options. Either wait for exceptional conditions where the routine fails exposing some of the invisible structures, or identify anomalies in the observations and follow-up with direct questioning. Both

of these approaches proved successful. Examples of exceptions are discussed in the next section on Social Learning Findings.

An example of following-up observations with direct questioning occurred with the Mission Director role during Exercise Pitch Black. It was observed that all the personnel in the Wing HQ were very busy, working towards the strict deadlines of the timeline. However, the two people performing the Mission Director role seemed to have time to engage in other activities such as liaising in planning for future exercises, and maintaining standard operating procedures.

A discussion with a senior officer about the Mission Director role revealed that the shape of the work at the Wing Headquarters had changed in the past two years from air tasking to mission tasking. This reshaping was due to the perceived need to facilitate interoperability with other forces in the future. To advance this need, new concepts and practices were being phased in. The Mission Director role is one of these concepts, with the Mission Director role gradually being re-shaped from being largely administrative to a future role much more involved in mission planning and execution. In this way, another catalyst for social learning became apparent to the team - the need to adapt to a changing work environment. Clearly, ethnographic observations need to be coupled with direct questioning, then followed by further ethnographic observations to facilitate understanding work practices and to reveal the otherwise "invisible" structures.

4. Communities of Practice

Many studies in learning focus on structured methods of training, as these are readily observable. This was certainly the case at SRG, where many structured processes of learning were seen. However, the research team believes that a focus on structured and explicit learning would exclude many social learning mechanisms.

Etienne Wenger's theory concerning communities of practice have been invaluable in helping the research team interpret and understand many of the observations made during the Pilot Study[3]. The theory proposes that communities of practice form an important link between the way that individuals and organisations learn. It highlights many methods by which knowledge is transmitted between community members. It blurs, from the perspective of community members doing their work, some of the boundaries between tacit and explicit knowledge, and formal and informal communication, The theory also proposes methods by which elements of practice can be propagated between communities, and the means by which different communities within an organisation remain in alignment with each other.
The section starts with a brief introduction to the theory of Community of Practice. It then describes the social learning mechanisms observed at SRG. These are organised into the following sections discussing: structured training, apprenticeships and legitimate peripheral participation, learning through mutual engagement, development trajectories, identity and learning through sharing and copying practice. Not every facet of communities of practice are advantageous, however; a section on knowledge incest highlights some problems that arise if the community loses access to new sources of knowledge.

[3] However, the research team claims no strong commitment to Wenger's theory. Although it explains many of the observations, it is possible it may be supplanted by other theories in the future.

4.1. Communities of Practice - A Brief Introduction

Wenger's theory starts from the premise that people make sense of the world through their engagement with it. Within a *community*, people learn by participating in its practice. Learning is a natural byproduct of this engagement and participation [Wenger, 1998].

Wenger argues that people working together on a joint enterprise, for a sustained period, form a distinct community. They learn, and as they interact, over time they develop a shared repertoire of concepts, beliefs, processes, tools and techniques. This shared repertoire is the practice of the community. Their *practice*, the relations they develop with their peers and their identification with the community bind them together. By this definition, one would expect that F-111 pilots, navigators and maintenance staff naturally form individual communities of practice, as would groups of F-18 pilots, politicians, research scientists and midwives [Wenger, 1998].

Practice, as envisaged by Wenger, covers an immense range of 'types' of knowledge. It includes the underlying world views, the assumptions that stem from them, the concept space of the community and the symbols they use. It includes their tools, artefacts, processes and procedures. It includes the roles that people fill and the settings in which they work. It includes the way they do things, and the knowledge or intuition that says when it is better to do one thing rather than something else [Wenger, 1998]. A community's practice encompasses all its knowledge, the explicit and the tacit[4].

A community's practice therefore serves to provide a context for its knowledge, processes and artefacts. A community's terminology, for example, will be an outsider's jargon. A navigation card or a mission plan for an F-111 mission is likely to make little sense to a member of the maintenance or logistics community. Given this perspective, it is easy to argue that knowledge is socially constructed and that learning is a process of enculturation, of becoming an 'insider' and learning to function within a community [Brown & Duguid, 1991].

[4] Because individuals will always belong to more to more than one community of practice, the knowledge of a community may well depend on knowledge possessed by other larger communities. All community members probably require some basic social skills which would be developed in childhood and adolescence. Many communities assume skills in reading, writing and numeracy.

4.2. Social Learning at SRG

In this section, the observations made by the research team regarding social learning mechanisms are documented. In the first part, the more structured methods for learning within the aircrew squadrons at SRG are described. They obviously constitute an important component of social learning. Where necessary, they will be related to Wenger's theory so as to give a broader theoretical perspective.

What was also striking was the extent that members of the aircrew world learnt from each other, both consciously and by osmosis, through processes of legitimate peripheral participation and mutual engagement.

4.2.1. Methods and Resources for Structured Training

Student pilots and navigators who arrive at SRG typically have already experienced a substantial degree of training. They will mostly have completed a degree at the Australian Defence Force Academy. They will have demonstrated their suitability for flying F-111s by completing fast jet training or by a successful career flying other service aircraft. During their first six months of training, they will focus on learning to fly the aircraft. During the remainder of their initial posting, and on subsequent postings, they will learn to fly the aircraft in operational roles. Their training involved structured courses, studying documentation and practical flying exercises.

In addition to learning to fly the F-111 aircraft operationally, student members of the aircrew community learn knowledge of aircraft systems, and to do sufficient maintenance of the aircraft to do basic maintenance during deployment. They learn the skills necessary to plan and participate in missions. They learn the pre-mission and post-mission procedures. They learn how to perform the secondary duties within the squadrons necessary for the squadrons to operate effectively.

There are many written procedures to draw upon. These include lecture notes, standard operating procedures, standing instructions, special instructions, tactical instructions and procedures and bench level instructions (for system knowledge and maintenance). For each position in a squadron, there is a folder termed the "gen", said to contain <u>all</u> the information needed by the occupant of that position.

4.2.2. Apprenticeships and Legitimate Peripheral Participation

New members of the aircrew community were seen to undergo "apprenticeships", where they initially perform simpler tasks, and where the complexity of the tasks they perform increases as their competence increases. For example, all squadron members are assigned secondary duties. A new arrival would be assigned to a junior position where he or she is given some piece of project work or workforce management to do. A typical small project would be to organise a very small deployment.

Apprentices learn by executing their duties and participating in the work of the squadron, working with and alongside more experienced colleagues, and drawing on the advice of their supervisors

and peers as required. They perform legitimate activities and use the same artefacts, and hence begin to learn the practice of the community. They interpret what they see, and bring their own knowledge and history to bear. As the same time, they learn the social and historical context that provides the broad context in which the individual artefacts, roles, tasks and actions have meaning. [Wenger, 1998].

An apprenticeship, however, is only useful, where the apprenticeships can do legitimate work and hence participate in the practice of the community to the fullest extent possible. This is certainly the case for the aircrew communities within SRG. Lave and Wenger have defined the term *legitimate peripheral participation* to describe such apprenticeships [Lave and Wenger, 1991]. The contrast would be situations where newcomers are marginalised to the periphery of the community, used as a cheap form of labour and not able to participate in the practice and learn the skills of the community [Lave and Wenger, 1991].

4.2.3. Learning through Mutual Engagement

Participating in a community such as SRG, as they learn the practice of the community, individuals are dealing with their fellows students and other community members. They will interact and learn from each other. It seems unavoidable.

A community's practice therefore arises from this mutual engagement, as knowledge is developed and propagated, and as people see what works and what does not. What is shared and learned also becomes a source of cohesion for the community and their practice marks community members as being different from members of other communities. The sense of mutual engagement in a common enterprise helps to generate a commitment to the practice and each other [Wenger, 1998].

The informal elements of interaction that are occurring at all times are as important as the formalised processes of interaction, as mutual engagement takes place in both formal and informal settings. Practice in the aircrew world has been structured so that members have many opportunities to learn from each other.

The benefits of mutual engagement manifest themselves in many ways:

- Students learn from their tutors and from each other on many levels, both in terms of 'formal' knowledge, and also by being exposed to the world views, attitudes and behaviours of their teachers and peers. Over time, for example, they see the way that other community members behave, and learn what is acceptable behaviour in specific circumstances. For a particular setting, they learn what cues to follow and what protocols are appropriate, to the point that they become instinctive. According to Wenger, "*they work together, they see each other every day, they talk with each other all the time, exchange information and ideas, and very directly influence each other's understanding as a matter of routine.*" [Wenger, 1998]

  There is now a de facto requirement for Commanding Officers, of squadrons and larger units, to attend Staff College. The staff at the Air Force Staff College includes many ex-

Commanding Officers. Part of the benefit of attending the Staff College would, presumably, come from interacting with, and learning from, the ex-Commanding Officers and one's peers.

Mentoring seems to be a more formal way that organisations use to institutionalise this process of interpersonal learning. The research team was told that inexperienced aircrew always flew with some one who was more experienced, so that they would learn from them.

- Through interaction and observation, individuals learn the practice of other community members. They see the duties their colleagues perform, the processes and artefacts they use, and their strategies when dealing with specific situations. All aircrew, for example, deal with the squadron Standards Officer and the Flying Programmers; junior officers will get some idea of what their work entails from their interactions with them.

  In an extreme case, where everyone is working in isolation, there are less opportunities for mutual engagement to occur. The research team was told that more officers now have offices, and that they spend more time working there. In the past, they were more likely to hold discussions in crew rooms or planning rooms. As a consequence, the team was told, learning which used to take place informally in these places now happens less frequently.

- Individuals form relationships with the people they are working with. These develop into social networks that are maintained assiduously. The research team was told that the F-111 community in Canberra meets socially on a regular basis, largely to maintain these networks.

  People can also learn to trust each other. This sense of trust is important in all working relationships, but especially so in the aircrew world, where one's safety depends on the actions of one's flying partner.

- Individuals learn what expertise each other individual has. It is no longer necessary to know everything, as it becomes feasible to make use of the knowledge of one's colleagues. Drawing upon their relationships from within their personal networks, their colleagues become resources who can be called upon to help meet a goal or complete a task. The community effectively forms a communal memory [Wenger, 1998] which can draw in active and inactive members.

Many of the more formal processes of mutual engagement take the form of peer review. The research team was told that peer review was largely responsible for the extremely high professional standards of aircrew.

Two examples of peer review are the boldface of the day and mission debriefs. The boldface of the day is a five minute briefing, during the Commander's morning brief, where a pilot or navigator attempts to demonstrate some specific knowledge of a subject area without hesitation. The mission debrief, occurring after every mission, covers the entire gamut of practice, from operational procedures, tactics, knowledge of aircraft performance parameters and protocols for maintaining awareness of the positions of other aircraft during formation flying. Because the success or failure of individual actions is generally easily determined, and because the participants

are all practitioners with some degree of competence, debriefs represent strong opportunities for the propagation of practice. The research team was informed several times that aircrew know what to expect from each other when flying.

The practice being learnt is never static. Change, in the external environment, policy, personnel or the supporting technological environment, is constant. The research team found that the practice amongst the various communities of practice continuously evolved, because of the ongoing learning of individuals and through continual negotiations among members.

4.2.4. Development Trajectories

Development trajectories summarise an important component of the way that people acquire competency in a practice at the tactical level of command. Hutchins has observed that "*As individuals become more skilled, they move onto other roles in the task-performance group, making way for less skilled individuals behind them and replacing the more expert individuals before them who advance or leave the system*" [Hutchins, 1996]. This progression of roles or activities that individuals undertake as they develop competence is termed a *development trajectory*.

Individuals at SRG were seen to follow a career trajectory, both over the short and long term. Junior aircrew, for example, through successive six-month periods progress through secondary duties of increasing complexity. This progression of roles corresponds to a development trajectory. When they rotate into the next position, they already have a good deal of knowledge regarding what the new duties entail, the sorts of problem they face in the course of their work, and the sorts of solutions that can be found. It is assumed that, at the end of a six-month posting, individuals have acquired a baseline of competence enabling them to fulfil a more demanding role. A squadron Senior Engineering Officer, for example, told the research team that he had already dealt with Senior Engineering Officers in his previous postings, and hence had a fair idea of what the job entailed.

Development trajectories ensure that elements of practice can be learnt in a measured way. They also ensure that the distribution of knowledge of the practice becomes more widespread, making it easier for the practice to be sustained. In addition, for roles that they have previously filled, individuals have learnt the perspectives that it entails. People also learn how the system should work and what might go wrong. The result is that the various systems acquire a degree of robustness against error.

Development trajectories within the military extend beyond a single posting. Aircrew must generally traverse standard career paths to reach a position of seniority. The research team was told, for example, that a stint as a qualified flight instructor was essential for career progression. To become an OC, one required previous experience as either an Executive Office or Flight Commander. On-the-job learning is augmented with short and long courses, including the Command and Staff Officers' course and the Commanding Officers' course at Staff College. The research team was told that officers, who have gone through an appropriate career development

path, are assumed to have 90% of the knowledge required for a position. The researchers were also told that F-18 aircrew follow similar development trajectories.

A community's practice provides the context in which its knowledge, procedures and artefacts make sense and an individual's development trajectory summarises the roles and positions that he or she has filled. Consequently, an individual's development trajectory partially summarises the elements of practice, which he or she will have encountered. The knowledge of the practice, implied by an individual's previous roles, enables them to understand the artefacts they will encounter in their new roles. They can therefore, for example, make sense and make use of "the gen" for their new secondary duty.

One example highlighted the importance of undergoing an appropriate career trajectory. A senior member of the Wing Headquarters told the researchers that after six months in the position, he was still struggling and that his time was constantly occupied with crisis management. He also said that he had not come through the normal career path, having come to the Wing Headquarters without any experience of the squadrons. It is likely that his difficulties were at least partially due to his not having a grasp of the relevant practice, because he had undergone a sub-optimal development trajectory.

The research team was told of several examples where a larger development trajectory, where officers were posted outside and then returned to SRG, were important for their development and to the development of the organisation. The posting of senior officers to Staff College is an example. The team was also told that officers posted to a joint headquarters were likely to have a better understanding of the Australian Defence Force and its processes. The larger development cycle contributes to the wider distribution of knowledge of the Australian Defence Force throughout its components; it should therefore make it easier for the different parts of the organisation to work together effectively.

4.2.5. Identity

Individuals are transformed as they become members of a community of practice. As they begin to adopt the world views, paradigms and culture of a community, they identify with the community. The change is quite fundamental. At SRG, the research team saw people who identified themselves as pilots and navigators; both groups identified themselves as members of the F-111 community. Aircrew from 1 and 6 Squadrons differentiated themselves from each other, and were seen to have substantial variations in their practice. At Exercise Pitch Black, the research team also saw F-18 pilots and navigators. Their practice and sense of identity was very different to that of their F-111 counterparts.

Community members do not shed their identity as soon as they leave the confines of their job [Wenger, 1998]. Just as doctors might think of people they meet in terms of their symptoms, or writers in terms of material for their next novel, members of the F-111 aircrew community will continue to identify themselves as such when away from their work place. Absorption into a community changes the way one perceives and engages with the world. Wenger's definition of

community membership reflects this; he says that one is a member of a community when one can be recognised as such by other community members [Wenger, 1998].

According to Wenger, individuals constantly renegotiate their identity as they encounter different elements of practice; identities therefore have a temporal aspect. This seems uncontroversial, as an individual's identity will change as he progresses through a development trajectory, for example, from a junior officer to the Officer in Charge of a Squadron. This development of identity is important because one's identity provides a context within which learning occurs, helping one to determine what is and what is not significant [Wenger, 1998].

4.2.6. Bricolage and Organisational Learning

Another significant concept is that of bricolage: the ability to "make do with 'whatever is to hand' "[Brown and Duguid, 1991]. Humans are social animals. Even when working on formal tasks, they will use whatever resources, social and material, that are available to them. When 'standard procedures' no longer seem adequate, they will improvise. They will develop models and knowledge that will enable them to achieve their goals [Brown and Duguid, 1991]. Given the unpredictability of working life, it is in fact unreasonable to expect them to do otherwise.

Although bricolage is done by individuals and small groups, it occurs within the context of a community's practice [Wenger, 1998]. Hence communities of practice are a major source of improvisation within organisations, and serve to link individual and organisational learning. Within the SRG aircrew community, the development of tactics probably falls closest to the concept of bricolage.

For an element of individual learning to become accepted as an improvement to a community's practice, it must first be 'captured' in some way so that it is accessible to other community members. The change needs to be evaluated in some way, either formally or by other community members incorporating the change into their practice. The change also needs to be propagated, to new and to existing members, for it to have any longevity. Hence this perspective raises research issues regarding how developments in practice are captured, evaluated and, if accepted, propagated through a community.

Within SRG, the squadrons have monthly tactics meetings where proposed changes to tactics are evaluated. Proposed changes are rigorously evaluated through discussion and simulation before being signed off by the Wing Commander. Any changes are then written into the Strike Reconnaissance Tactical Instructions, which are then circulated within the Headquarters and Squadrons. SRG, therefore, has a formal process to capture, evaluate, propagate and hence maximise possible improvements to tactics. A problem with this approach in peacetime, however, is that it 'takes months' for changes to be accepted.

For Wenger, a key issue is the organisational politics and structures that support the development of practice through bricolage. He uses terms such as peripherality, marginality and ownership of meaning. These terms describe the degree of control a community has over its artefacts and practice, and the extent to which its practice is shared and acknowledged through the larger

organisation [Wenger, 1998]. At SRG, the organisational structures maximises the aircrew's ownership and control over their practice by acknowledging and using their expertise. The research team saw several examples where junior aircrew had significant input into decisions because, within the squadrons and headquarters, they had the current expertise in the systems being discussed. Equally important, it is not the most senior person in terms of rank who leads a mission, but the individual with the most current expertise.

If individuals within communities of practice are a major source of improvisation, a way of maximising such improvisation is to give the practitioners time, and perhaps tools, with which to reflect on their practice. The executive group of a squadron was seen to be working through several improvements to training procedures and to the practice in general. As senior holders of the squadron's practice, they were in the strongest position to improve it.

4.2.7. Knowledge Incest

Wenger goes to great lengths to stress that communities of practice are not panaceas for all learning problems. One potential problem that the research team was told of at SRG was that of knowledge incest, where the community loses access to other sources of ideas. In one of the squadrons, the research team was told that the crew room was an important setting for communication and learning. They were also told that this method of learning is very incestuous, because the squadron is the source of what is learnt, and individuals tend not to become exposed to outside knowledge.

Exchange tours with overseas pilots, to and from equivalent components of the U.S. Air Force, becomes quite important in this context, as they are a way in which SRG attempts to minimise this problem. The research team saw a mission, where aircrew from different squadrons flew together, with the aim of standardising practice.

The research team was told of one officer, who was to be promoted from Executive Officer of a squadron to Commanding Officer of another. The concern was expressed that the quality of his command might suffer because he would have insufficient exposure to outside knowledge and ideas.

An appropriate development trajectory, where individuals are taken outside their local communities, is seen to be essential for the development of SRG officers. The research team was told that a commanding officer, who has only done flying, will probably be excellent in a strictly operational sense, but is likely to be much less competent in other areas.

4.2.8. People Linking Communities – learning through sharing and copying practice

Communities of practice rarely exist in isolation. Instead, they form part of what Wenger calls c*onstellations of practice* [Wenger, 1998]. It is likely that any organisation can be idealised as a constellation of communities of practice. This seems to be the case at SRG if one treats headquarters, and small groups of individuals (such as the Legal Officer and Chaplains), as communities. Communities may also belong to organisations that fall outside a simple

organisational structure. The Chaplains and Legal Officers belong to communities spanning the ADF; each Chaplain of course belongs to a much wider religious community.

People can link communities in several ways. Inevitably, individuals will be members of more than one community at a time; this *multimembership* is the simplest means of linking communities. Individuals will generally try to make sense of the relationships between the practices of the different communities to which they belong.

Such individuals may act as *bridging agents*, when they work to align at least some of the activities of the communities to which they belong. A prime function of headquarters staff, for example, is to align the activities of the communities, which they represent - the work of the Intelligence Squadron Leader at 82 Wing very much fits this pattern. An issue would generally be discussed and resolved within the Squadron Headquarters and the respective, related communities before any formal documents are likely to be issued [O'Neill & Gori, 1998].

SRG make good use of the posting cycle by posting staff into project and acquisition positions which directly impact upon the F-111 world. Such staff become members of a second community, and can act as bridging agents between the two communities. The benefit works both ways. The second community obtains current knowledge of the F-111 world. The advantage to the F-111 communities is that new capabilities are functioning very soon after they are introduced. Apparently, this was not the case prior to the introduction of this policy. This use of bridging agents facilitates organisational learning.

Individuals may also act as *brokers*, who can take elements of one practice, adapt and introduce it into another. For example, SRG has an aircrew exchange program with the USAF. However, the USAF no longer flies F-111s operationally. Rather than this being a disadvantage, the research team was told that this would be a good opportunity for the F-111 aircrew community to obtain an influx of new ideas. The aircrew from the USAF, therefore, act as information and learning brokers for the Australian F-111 community.

5. Power

Understanding workplace interactions and social learning which occurs at SRG requires some insight into dimensions of power within the organisation because power is central to what gets out and becomes knowledge. The questions posed here are the same as those posed by Foucault [Foucault, 1979; 1980]. That is, 'how is power exercised, by what means?' Secondly, 'what are the effects of the exercise of power' in terms of social learning and knowledge transmission. These are different to merely asking what is power and where does it comes from?

An understanding of Foucault's notion of power is necessary to look at interactions at SRG. For example the data shows that rank and hierarchy do not in themselves dominate power relations. That is, when it comes to aircrew and to some extent at headquarters level, currency rather than rank feature more dominantly. In this way one can not simply say that power and rank are inextricably linked. In allowing the data to inform the understanding of power, one begins to see

that power and power relations at SRG are not set according to the hierarchy of the military, but rather, arise from a multiplicity of manoeuvres, tactics, techniques, and functioning.

During Exercise Pitch Black for example, the research team observed the ways in which the Commanding Officer demonstrated his authority. Basically his authority stems from his rank, as well as knowledge and expertise that he has developed over the years. In this way he has legitimate power and theoretically has the right to impose certain kinds of directives and decisions regardless of the wishes of those under him. He also can legitimately raise his voice and vent his angry publicly. However, if he wants to retain favour with his staff, he must allow others to rightfully call in their own authority and he must listen to their expert knowledge and advice. Moreover, as the research team observed, different leadership styles are needed at different times and in different spaces wherever authoritative knowledge is used across people, communities of practice, and activity systems. In terms of social learning and knowledge transfer this is central as it demonstrates that even those of junior ranks are not powerless, but indeed they too are integral for the transmission and future investment in the learning that occurs around, in and through them.

Another important aspect in Foucault's analysis of power is that wherever there is power there is resistance to that power. This is important in relation to this particular social world because the types of resistances that take place will possibly give some indication of how knowledge is created, what knowledge becomes corporate knowledge and so on. Moreover, the interrogation of the question 'how is power exercised?' is important if one is to understand the effects of power in terms of the knowledge which is produced and transmitted by it. In any workplace there are relations of power, which permeate and constitute the whole. The establishment and implementation of such power relations is directly correlated with the production and circulation of 'true' knowledge at SRG. Power is inextricably associated with the emergence of particular applications of knowledge and the formation of social learning in the various SRG worlds. When it comes to power relations in the SRG worlds there are a number of cultural discourses, surrounding the role of reservist / non-reservist; pilot / non-pilot which were observed. A senior reservist would often defer to a junior non-reservist and a senior administration officer, in some instances, would defer to a junior officer who happens to be a pilot. Thus, in some ways, rank becomes less relevant than the actual work personnel do.

The exercise of power can also be seen when an opportunity arises for interest groups in an organisation to promote or defend their political positions [Dawson, 1986]. Pfeffer [1981] identifies three major conditions under which power is likely to be exercised: interdependence between individuals or units, heterogeneous or inconsistent goals, and scarcity of resources. Furthermore, as roles in an organisation become more defined by the information people hold and control, they will view that information as a source of power and importance and be less inclined to share or devolve that responsibility [Davenport et al., 1992].

5.1 Discipline or Surveillance and it's Connection to the Function of Power

How people do their work and maintain their currency is closely connected to Foucault's concept of surveillance [Foucault, 1979; 1983]. Discipline, is maintained not through direct force or violence but via surveillance. In fact if SRG were to use direct force to ensure that discipline is maintained and that people do their jobs, then this would probably mean that they have failed as an organisation. The subject of surveillance disciplines him or herself rather than be disciplined by an outside force. This occurs in a number of ways.

First, it occurs through the spatial distribution of individuals in certain ways. The distribution of space is achieved by keeping certain groups of individuals from others, (aircrew from non-aircrew) or by a network of relations of rank (officers separated from airmen). By these procedures members know their place in the general economy of space associated with disciplinary power. For example during the Pitch Black Exercise the way that the physical space was constructed during the morning Brief is important. The speech used was formal with careful selection of words and phrasing of sentences. Moreover, spatial arrangements in the briefing room, encouraged, discouraged and at times precluded certain ways of behaving. Participation from the audience only took place when the Mission Commander invited them. People knew instinctively which cues to follow and what protocols were appropriate in this particular setting.

A second manifestation of discipline at work is the way activities are brought into effect. The control of activity through time scheduling is important here. Daily timetabling, following through a mission cycle, learning to fly or navigate an aircraft all rely on a stringent control of activity through time scheduling. This is directly relevant to pedagogical practices. Disciplinary power develops a general code for the transition from student to master, put into practice in various fields of learning. It codifies segments in terms of a hierarchy, where each stage of the learning process is significantly more difficult than the last. This enables the development of skills to be carefully monitored while also providing a way to differentiate, or individualise novices. The issue of learning as a gendered process is also relevant here. The research suggests that the valorisation of masculinity is central to an overall understanding of work and on-the-job learning. One implication this has is that men monitor themselves and each other in relation to appropriate masculinity when it come to learning and work practices.

6. Lessons Learned from the Pilot Study

The following lessons can be drawn from the work so far:

- Social learning is a complex, multi-layered social system
- Social systems are as complex as technical systems
- The informal aspects of social learning are as important, if not more so, than the formal, organised aspects of organisational learning
- Informal aspects of social learning are not yet supported by technical systems
- Social structures become more visible when they fail, or when an exception is noted
- Ethnography is a very useful methodology for understanding and analysing the social aspects of socio-technical systems.

The success of the ethnographic methodology for this research suggests there may be a much wider role for this form of information gathering. Ethnographic immersion in a setting, particularly if conducted by multi-disciplinary teams of researchers, may be the best way to fully understand and analyse social systems in a work setting. Such ethnographic immersion is likely to be the best way to ensure successful optimisation of both the social and technical aspects of computing systems development.

It is too early to conclude that the social learning architecture to be developed from this study will definitely lead to better systems specifications for more useable and enduring systems. However, it can be said, with some confidence, that this task will certainly lead to an enhanced understanding of the social structures that most successfully support people working, learning and collaborating in command and control in the ADF.

7. Conclusions

This paper explores a number of issues pertinent to the ethnographic Pilot Study that took place during 1998 at the Strike Reconnaissance Group Queensland. Some of the concerns raised here include the immediate restrictions placed on the study and the way in which the military setting itself shaped the ethnography that took place. Also highlighted in this paper has been the team's on-going process of negotiation in particular in regards to what each team member saw as being the key areas for exploration. It was found that the different backgrounds of each ethnographer often resulted in previously unrecorded observations being exposed. Thus the field notes became a boundary object for initiating conversations, rather than the final record of what had been observed.

Acknowledging one's own subject positioning as a researcher in the field has also been discussed within this paper. Each team members saw the SRG world not only through narratives of themselves but also through the discourses of the intellectual worlds in which they each belong and the intellectual worlds of those whom they are working with. Over the duration of the project the individual ethnographers have all come to see how far they can push a particular agenda and when to hold back. They also saw that 'getting it right' does not mean understanding the SRG culture in exactly the same way as everyone else does, but rather, presenting the understandings of this world in various individual ways. giving a multi-layered understanding. This also entails knowing the ways in which the individual ethnographic practice can be varied in the particular setting being studied.

The paper continues by reporting on some of the major social learning observations and conclusions derived from the study, particularly in regard to communities of practice. Issues arising from the research include the importance of: apprenticeships and legitimate peripheral participation; learning through mutual engagement; development trajectories; identification within the community; bricolage; and organisational learning. The problems of knowledge incest were also highlighted. Another key element in understanding the workplace interactions which occur at SRG requires some insight into dimensions of power within the organisation. Understandings of power is integral to constructions of knowledge. Not unrelated to this is the concept of

surveillance in the workplace where a subject's self surveillance helps to maintain and reproduce a strong core of discipline.

The Pilot Study has been seen to be successful from the military's perspective, DSTO's perspective, and the research team's perspective. The project validated the utility of ethnography, and the concept of social learning as a result the ethnographical research will continue in a new setting next year. The challenge in future research is to extend beyond the boundaries of an activity system or community of practice. Instead, there needs to be a further examination of the relationship between activity systems and communities of practice, and how these relationships are renegotiated across axes of power, gender time and space. These types of studies will be relevant to both the business community which is becoming increasingly inter-dependent, and the work of military headquarters.

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