Organisational Factors Influencing the Diffusion of Process Innovations from Manufacturing to Health Services Settings

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Abstract

Background: This paper presents an Organisational Behaviour perspective of organisational factors influencing diffusion of innovation in a medium-sized tertiary public hospital. The innovation consists of applying Lean principles coupled with computer simulation of process changes. The diffusion of product innovations is well documented in the innovation management literature. However, the diffusion of process innovations across industries is relatively unexplored. In the last twenty years Lean manufacturing techniques increasingly appear in health settings accompanied by reports of quality and financial gains, and warnings of workforce resistance. Aim: This research addresses an important gap in theoretical and practical knowledge through examining the organisational factors that predispose a public hospital to adopt process innovations originating outside the health sector. Methodology: Case research was used to examine an early adopter of Lean thinking coupled with computer simulation to analyse and optimise patient flow between Emergency and Imaging Departments. Semi-structured interviews with key informants were combined with analysis of government and hospital policy documents and internal surveys in a retrospective evaluation of recent changes to scheduling processes. Thematic analysis was used to identify organisational factors that influence diffusion of innovation in health settings, including culture, leadership and links with other organisations. Findings: The influence of intra-organisation factors, including but not limited to a recent organisational crisis, culture, attitude to risk taking, tensions prompting change and informal inter-organisational networks were evaluated. Hospital leadership emerged as an important factor in reducing insularity within the organisation. Clinician cohort age and crisis conditions (real or perceived) appeared as factors influencing diffusion of innovation. Conclusions and Implications: Hospital characteristics supporting the adoption of performance-enhancing innovations from dissimilar settings are reviewed in the context of a recent improvement project. The cultural acceptability of highly empirical quality improvement techniques (evidence based management) to professionals accustomed to evidence based medicine is also considered.
Introduction

This paper is part of a suite of three papers that collectively present a holistic examination of the diffusion of an innovation within a health services setting. The innovation comprises the application of Lean quality improvement methods, complemented by computer based, visual representations of the potential process changes. This paper argues that the demonstrated efficacy of Lean thinking and visual simulation in industries such as manufacturing helps to encourage acceptance of continuous improvement models of process innovation in health care organisations. It also identifies new factors supporting innovation in an early-adopter hospital.

The diffusion of product innovations is well documented in the innovation management literature (Rogers, 2003). However, the diffusion of process innovations across industries is relatively unexplored. In the last twenty years Lean manufacturing techniques increasingly appear in health settings accompanied by reports of quality and financial gains, and warnings of workforce resistance (Graban, 2009; Radnor & Boaden, 2008; Tucker, 2008). The diffusion of Lean thinking from manufacturing to health settings in NSW is in its infancy. The paper commences with a review of pressures for change in public hospitals in New South Wales (NSW) and continues to introduce Lean thinking and the use of computer simulation to trial potential process improvements. It then focuses on an early adopter hospital to review organisational factors which influence diffusion of process innovations.

Public Hospitals in the New South Wales Health System

At an organisational level, hospitals in NSW are expected to meet ideals of equitable, efficient and effective health services while facing increasing demands for assistance. The Australian National Healthcare Agreement (Department of Health and Aging, 2009) states Australia’s health system should: address the health needs of individual patients, families and communities, prevent disease as well as treat illness, promote healthy...
lifestyles and provide all Australians with timely access to health services based on need, not ability to pay, regardless of where they live. Simultaneously, changes in delivering care, increasing expectations, economic constraints and changes in the health workforce combine to make meeting these ideals more and more difficult (Department of Health and Aging, 2009). Unfortunately, not only is the incidence of chronic disease on the rise, but a large number of people suffer from more than one chronic health condition at the same time (Department of Health and Aging, 2009). These factors place growing pressure on existing services and providers, and combined with growing fiscal pressure, focus government attention on public health system efficiency and efficacy.

Australia does not face these issues alone. Many OECD nations are experiencing similar challenges and increasingly apply business management methods with proven track records in other industries, to health services settings (Boston Consulting Group & Knowledge @ Wharton, 2009; Organisation for Economic Cooperation and Development, 2002). In NSW, hospitals have adopted the use of Key Performance Indicators (KPIs) from business settings. Each hospital’s and area health service’s performance is compared to peers and published on-line (NSW Health, 2009a, 2009b). Data are easily, and frequently extracted into critical newspaper articles (for example, Wallace, 2009).

Some scholars have called for disruptive innovation in health services systems. Christensen et al. (2009, p. 420) assert that because hospitals contain each of the three generic types of business models (diagnostic ‘solution shops’, value-adding process businesses and facilitated networks), poor coordination and inefficiency is inevitable. They continue ‘The general hospital is not a viable business model. In the absence of an array of cross-subsidies, restraints on competition and philanthropic life support, most of them would collapse’ (Christensen et al., 2009:420), and predict that disruptive innovation, bringing simplified, inexpensive health services to large numbers of clients, is most likely to occur in corporate-like organisations.
However, of the one hundred and twenty three recommendations of the Australian National Health and Hospitals Reform Commission Report (2009) none recommends the abolition of hospitals. For the foreseeable future tertiary care in NSW will be provided in hospital settings, which, as Nembhard et al. (2009) identify, are likely to resist innovation due to: the nature of health care work (high uncertainty coupled with risk of patient death), workforce characteristics (occupational hierarchies, strong professional and weak organisational identification), leader-workforce relations (transactional exchanges and perceptions of conflicting goals) and weak performance measurement and reward systems.

These organisational characteristics suggest that attempts to use disruptive innovation (Christensen et al., 2009) to remodel health systems have a high chance of failure, and may elicit fierce resistance. In the past NSW nurses and doctors have taken industrial action (Arnold, 1984) and attempts to improve health service organisations are likely to succeed only if they occur with the support of these powerful groups. However, continuous innovation improvement techniques have been used successfully in Australian health care settings (Hyland, Davison, & Sloan, 2003).

Diffusion of Innovation (DoI) theory can assist in the identification of process innovation approaches likely to be acceptable to health services personnel (Greenhalgh et al., 2004), and to supply the ‘laggard’ health industry with tools to improve process quality and efficacy with low risk levels (Nembhard et al., 2009). This paper examines a recent case of DoI, namely the use of Lean thinking and computer simulation to identify and model potential process changes, diffusing from manufacturing to health.

**Organisational Diffusion of Innovation**

There are many definitions of innovation, with no consensus on what constitutes a good working definition (Johannessen, Olsen, & Lumpkin, 2001). Most definitions link the discovery or creation of something new to its practical application. Attempting to make sense of the inconclusive and inconsistent findings that characterised studies of
innovation, Wolfe (1994) organised prior research into three research streams: Diffusion of Innovation (DoI), Organisational Innovativeness and Process Theories. DoI research tracks the adoption and spread of innovations within and across organisations and markets, and Rogers (2003) identifies adopter categories as a way of classifying individuals based upon their propensity to innovate. Although originally created to investigate individual decisions to adopt or reject innovations, DoI theory can also be applied to organisational innovativeness (Rogers, 2003). Rogers’ (2003: 281-285) five categories of adopters, translate to an organisational setting as follows:

- **Innovators**: The first organisations to adopt a particular innovation, approximately 2.5% of the population
- **Early adopters**: The next 13.5% of the population, characterised by opinion leadership and a high degree of respect from peer organisations.
- **Early majority**: Adopt new ideas just before the average organisation and comprise about 34% of the population.
- **Late majority**: Making up 34% of the population this group will adopt innovations, often as a result of economic necessity and peer pressure
- **Laggards**: The remaining 16% of the organisational system, have lengthy innovation decision processes and adoption occurs a long time after initial awareness of new ideas. The term ‘laggard’ is not intentionally pejorative, and slow adoption of innovation may be justified by limited resources and exacting performance standards.

The hospital forming the case for this study is either an innovator or early adopter of Lean thinking and process re-design. This assessment is made on the basis of it being one of the first eight of over two hundred and twenty NSW hospitals participating in a major process improvement project.
Innovation in Health Settings

This work adopts the definition of innovation in the context of service delivery in health settings put forward by Greenhalgh and colleagues (2004: 582) as ‘a novel set of behaviors, routines, and ways of working that are directed at improving health outcomes, administrative efficiency, cost effectiveness, or users’ experience and that are implemented by planned and coordinated actions.’ Lean thinking is examined as a way of developing strategies for reducing waste, and computer simulation techniques are a way of communicating the result of process changes.

Lean Thinking and Computer Simulation

Lean Thinking

Lean (systems, thinking or philosophy) is the name commonly given to the manufacturing methodologies developed by Toyota as the Toyota Production System. Lean enlists the knowledge and skills of people who perform the process in identifying and removing eight types of process waste, through the use of continuous improvement methods (Liker, 2004; Womack & Jones, 2003).

Adaptations of Lean manufacturing process techniques (Liker, 2004) appear more frequently in health services than any other public service context (Radnor & Boaden, 2008). Over the last twenty years the number of Lean public health projects has rapidly increased. The pace and spread of Lean techniques in public health services is likely to continue accelerating as governments either mandate or encourage their adoption as part of quality-improvement and cost-reduction programs.

Computer Simulation

Operations research, especially in the areas of systems redesign, modelling and simulation offers proven methods to understand problems related to patient flow in more depth and to envision innovative ways to efficiently resolve issues and improve the provision of care (Elkhuizen et al., 2006). Process improvement initiatives involve
implementation of new models, revision of existing models and expansion and strengthening of processes. El-Haik and Al-Aomar define simulation as:

“… a disciplined process of building a model of an existing or proposed real system and performing experiments with this model to analyse and understand the behaviour of selected characteristics or a real system so as to evaluate various operational strategies to manage the real system.”

Simulation tools provide a complementary development to the increasing use of process redesign initiatives in hospitals and permit a virtual trial of a process change prior to physical implementation. Other advantages of process simulations include: managing risks by preventing defects and reducing costs, preventing or eliminating unforeseen barriers, bottlenecks and design flaws, ensuring resources are allocated to support customer satisfaction and facilitating communication among multifunctional team members (El-Haik & Al-Aomar, 2006).

Simulation techniques have the potential to address some of the factors Nembhard et al. (2009) identified as contributing to slow adoption of innovation in health settings. Combining visual simulation with Lean thinking has potential to improve hospital quality and efficiency, in a way which addresses the unique characteristics of health organisations. A detailed description of the method used to simulate processes in the sonography department is provided in Eljiz et al, (2010a).

**Diffusion of Innovation in Health Settings**

Greenhalgh and colleagues’ (2004: 581) systematic review, conducted on behalf of the United Kingdom’s National Health Service, examined, ‘How can we spread and sustain innovations in health service delivery and organization?’ Greenhalgh et al. concluded that many organisational factors influence the degree of innovation adoption. The main organisational factors identified are: culture and climate, leadership style, power balances, social relations, attitudes to risk taking, inter-organisational networks and collaboration, absorptive capacity for new knowledge, effective Human Resource
Management, structural determinants (including size), system readiness for innovation (including tension for change and availability of time and resources), intra-organisational communication, external change agents and effective data capture systems.

The hospital examined in this case study is a medium-sized tertiary public hospital. The hospital has close to 1,200 full-time equivalent staff, approximately 200 patient beds and is a teaching hospital. This paper considers the macro-level influences on DoI in a NSW hospital, complementing the group (Eljiz et al., 2010b) and individual perspectives (Eljiz et al., 2010a) on DoI in the hospital, also presented at this conference.

**Methodology**

Case research (Stake, 2000; Yin, 1994) was used to examine a health sector early adopter of Lean thinking coupled with computer simulation. To optimise patient-flow between Emergency and Imaging Departments, Lean thinking was applied to Sonography Department processes scheduling, transportation and scanning processes. Organisational data collected included three semi-structured interviews with key hospital informants, examination of internal documents and reports in the public domain and observations at the hospital. The semi-structured interviews centred on perceptions of innovations originating outside the health sector and organisational factors that influence the DoI. Researcher observations, spanning more than two years, included data collection, modelling, simulation and implementation of process changes, including interactions between Emergency Department and Imaging Departments.

Thematic analysis (Ely et al., 1991) was used to identify group factors that influence the DoI in health settings. Rogers (2003) warns of the danger of DoI studies based on data obtained from a single individual, generally the top executive in the organisation. This study uses three informants with extensive organisational experience in the hospital; an Executive Manager, a Clinician Manager and an academic with a longstanding association with the hospital. Themes from these interviews were combined with the
material collected for individual and group analyses of DoI in the hospital to provide a comprehensive understanding. The interviews recorded and transcribed verbatim. QSR N-Vivo® software was used to aid detailed coding and analysis of the collected research material, facilitating the interpretation process. Member checks, in which the data and interpretations were provided to participants for correction, verification and challenge, were used to increase the credibility of the research.

Research Findings

This section highlights the key findings regarding macro determinants of DoI in the hospital, illustrating and extending those identified by Greenhalgh et al. (2004). The factors extracted by Greenhalgh and colleagues in their meta-analysis of DoI studies carried out in health settings are largely present in the case hospital. Additionally two new factors, average age of doctors and perceptions of organisational crises were reported to strongly impact the hospital’s approach to innovation. Space constraints prohibit the provision of detailed definitions for each of the factors listed below. We recommend Greenhalgh et al.’s 2004 work for an introduction and selected authors are referenced within each section.

Culture and Climate

The hospital’s culture (Martin, 2002) is not considered stable or ‘mature’ by respondents, with comments indicating the organisation is in a state of ‘cultural flux’ as it experiences rapid growth. As the Executive Manager commented:

I would say is that this is an immature organisation that’s trying to deal with an increasing and significant workload. ... the culture is immature. ... and it needs to grow and develop and broaden its views and thinking.”

This suggests a cultural openness to change and innovation; in order to fulfil its obligations and potential, the hospital needs to ‘grow and develop.’ Staff reported that
they enjoyed their work in the hospital, and although occasionally problematic, inter-occupational relationships were generally positive.

**Leadership Style**

Three themes in the interview material related to leadership, specifically: eliciting support from clinicians, using process improvement as a learning, not blaming experience for the departments and individuals involved, and focusing on measuring and improving hospital performance. Clinicians’ responses to management innovations were described as passive to resistant if they were not explicitly involved at the beginning of the initiative and their support won in early stages of the project. The value of clinical support was iterated by all respondents, and such support is more likely to be forthcoming if innovation participants believe the objective is to improve performance. Several examples of leaders encouraging engagement and learning were given. For example, the Academic explained that:

“[the GM] did not necessarily give a directive, when you get a directive from the GM to closely investigate one department that can go very wrong. [The GM] actually strongly suggested that the medical clinicians in the Emergency Department would speak with the medical clinician in the Imaging Department. So there was a medical-medical interaction...”

Nembhard et al., (2009) identified a leadership style encouraging learning and experimentation rather than inspection and blame as key to health organisation innovation. Risks of departmental insularity were consciously addressed in the hospital by bringing clinicians around the same table to engage in joint identification of problems and potential solutions.

Local leadership was reported to support innovation within the hospital, in contrast to what some staff see as overly aggressive change schedules being set by the Area Health Service (AHS). The Executive Manager described that while process changes required an extended period of time to implement, the AHS expected one year to be sufficient:
“Some of those were structural changes but there also were some process changes and I’ve actually asked the department to give me another year. ... the department doesn’t do long term ...”

Leadership is recognised as part of, not the total solution to changing processes inside the hospital, and making the changes permanent. Structures, processes and leadership were reported as necessary to make process innovations ‘stick’, relying on individual’s influence to maintain changes was not sufficient:

“We’re putting good managers into departments, we run a good department for a period of time, we take the manager out and the department falls apart!” Executive Manager

It became clear from interviews and observations that the Executive Manager regards the hospital as ‘the business’ with a managerial focus on measurements and improvements. While the first preference is to consult and convince various stakeholders and especially clinicians of the need for change, the Executive Manager is willing to be directive if required:

“The authority of the place and the final decision is mine, and I will exercise it. But I do it in conjunction and in collaboration with the people that I work with, we talk constantly about what we’ll do, how we’ll do it, why we’ll do it that way.”

The Executive Manager starts problem solving with engagement, moves to inspection, then to directive guidance if the first two approaches not delivering desired results.

**Power Balances and Social Relations**

As is well documented (Fahey & Burbridge, 2008; Nembhard et al., 2009; van Duivenboden & Thaens, 2008), power relations in health services have significant impacts upon organisational performance. According to the Clinician Manager the hospital was viewed as:
“... run predominantly by managers and professional nursing staff, rather than medical staff, and there is a fair degree of resentment among the medical staff in that situation.”

This assessment was supported by the Executive Manager:

“I think the culture here is very nurse driven ... I’ve worked in other organisations where it’s very medical ...”

However, a dramatic improvement in intra-organisational relations occurred during the last four years, in the aftermath of a public inquiry into the hospital’s performance, as described by the Executive Manager:

“... that was the culture four years ago. I mean, we fought with everyone, Medicine, Surgery, Administration. No-one wanted to talk to us. But it’s different. You can talk to anyone now.”

The necessity of clinician engagement was reiterated by all informants in relation to power balances in the hospital. The Executive Manager commented:

“... health management is an absolute partnership between clinicians and management. If you don’t work in partnership between the two, (but this group here is quite good, can I say), you can pull a place apart. So a management change process that clinicians do not engage with, I’m telling you, will not work. It hasn’t got a hope of surviving.”

Slow change processes in health settings were attributed in part to medical professional autonomy. All interviewees spoke of the challenges of engaging clinician support and the Executive Manager described one reason for prolonged discussions:

“Well I have to argue up, down and across, around-about because they see it’s their domain to run health services. That is the challenge in health because people are trained in a particular way, they see their professional status and their professional knowledge and skills as very important to them. I think that’s why the change process takes so long.”
Respondents agreed health organisations were slower to change than other industries, and ascribed this to the complexity of inter-connections within the hospital, and the necessity of discussing forces for change with and eliciting support from a wide range of clinicians.

**Attitudes to Risk Taking**

The word ‘risk’ seemed almost taboo to the interviewees. According to the Academic:

> “I don’t think they would put anything at risk, ... I would not call them risk-takers in any which, way, shape or form.”

This is understandable. In hospitals, and particularly in Emergency Departments, managers work to control sometimes chaotic situations and, consistent with a professional bureaucracy organisational design (Mintzberg, 1980), the culture promotes risk aversion. When conducting research in medical settings it may be more appropriate to refer to willingness to experiment or similar term instead of mentioning risk. Interviewees expressed a preference for another organisation or industry to act as a test bed for innovations to make hospital adoption ‘low risk’.

The relative risks of clinical and management innovation are clearly different to the organisation, and while regulations control clinical innovation, management innovation is not as constrained. The Clinician Manager explained:

> “…one of the problems is that there is a lot of bureaucracy and red tape that get involved in introducing new procedures and new techniques, and that is a rate-limiting factor. If it’s [innovation] on a managerial or an organisational platform then it would be much more likely to get changed rather than the introduction of new medical procedures for instance.”

While hospital members acknowledged themselves as innovative they felt the hospital’s relatively small size gave them greater freedom to experiment because:

> “… the Area Health Service concentrates most of its attention on the primary teaching hospitals, …” Clinician Manager
A cultural openness to change combined with the flexibility to implement management innovations supports an organisation’s absorptive capacity as discussed in the next section.

The above results indicate that the culture and leadership style evident at the hospital are likely to support DoI. Power balances and social relations, while not negative, are reported to prolong discussion of change and require conscious management, while risk is viewed negatively. Human Resource Management and structural factors did not feature prominently in discussions of organisational DoI at the hospital. The remaining organisational factors theorised to influence DoI, and two factors that may be unique to the case organisation are now addressed.

**Absorptive Capacity for New Knowledge**

Absorptive capacity may be summarised as the combination of an organisation’s ability to identify innovations in its external environment and adapt and adopt them for its own use (Cohen & Levinthal, 1990). Respondents reported that the origin of an innovation, particularly management innovations was not important. There was no evidence of a ‘Not Invented Here’ syndrome and the ability of an innovation to produce results was the main criterion for acceptance. In fact the Clinician Manager reported:

“*There’s a definite need for them [ED] to improve their performance and as such they would be happy to try and adopt anything that looks like it might help.*”

Pressures to increase performance can be seen to encourage the hospital to consider approaches from outside the traditional boundaries of clinical practice.
Inter-Organisational Networks and Collaborations (including political directives)

Hospital staff members report active links with consultants, universities and AHS groups that all act as sources of management innovation. The AHS also plays an important political role. An example was given of a five year ‘trial’ of measuring and reporting Emergency access times, before the process and targets became AHS official policy and were enforced with threats of on-site reviews for hospitals consistently failing to meet set targets.

System Readiness for Innovation

System readiness for innovation includes tension for change and availability of time and resources. Reports of pressure for change created by restricted resources dominated the interviews. For example, from the Clinician Manager:

“We have very limited resources, and constraints on us in terms of the amount of money and the staff we can get in the hospital. One of our major functions is to allocate our resources satisfactorily or optimally, to try to cope with demand. ... as the hospital has grown the resources in the department haven’t been changed in the last ten years. We’ve had one new Ultrasound machine.”

Respondents reported significant pressures for change from all directions: top down in the form of directives from the NSW Department of Health, bottom up from increasing patient presentations at the Emergency Department with an increased occurrence of co-morbidities and increased demand for imaging diagnostic services by hospital specialists, and even sideways, from comparison with Radiology services in the private sector:

“If you compare what they do in private, to the public but everyone says “You can’t compare apples and oranges!” and that’s true, but why does one test in the private [system] take 15 mins and in the public [system] it has to take 40 minutes?” Academic
These pressures do appear to increase staff and system readiness for innovation. The Executive Manager was confident staff recognised the need to change processes rather than expect more staff or funding:

“... [the hospital] will look at different ways of doing things or different ways of running it’s services because it hasn't got the senior clinicians to do it so innovative models get developed because there aren't people on the ground to do the work sometimes.”

The hospital is innovative in a number of ways, having pioneered overseas recruitment and developed a strong ambulatory care program to compensate for staff shortages, and staff members openly acknowledge the role of pressure increasing their readiness to innovate.

**Intra-organisational communication**

Despite obvious commitment and practice in eliciting support through consultation as reported in earlier sections, there are gaps in communicating to some groups about some innovations. As discussed in the paper focussing on group level factors influencing innovation at the hospital, (Eljiz et al., 2010b) communication of change needs to encompass all people impacted in any way.

**External change agents**

External change agents came primarily from the organisations identified in inter-organisational links: consultants, universities and the AHS. These external change agents did not require a medical background to be accepted, but did need to be willing to spend time in and understand the characteristics of hospital settings.
Effective data capture systems

Interviewees confirmed the role of ITC in their process innovations, particularly in monitoring compliance and recording progress. The Executive Manager described two examples:

“... initially people were saying no-one had breached but when I did a cross-check on the report, people had breached. So it took about a month.”

Similarly for another process:

“...we have to go away and make sure we’ve got a database that will give this information and create the reports so it’s never just easy.”

The above results conform to the factors Greenhalgh et al. (2004) identified from their systematic literature review of diffusion of service innovations in health settings. Two new factors were described as exerting a strong influence on the acceptance of Lean thinking and computer simulation of process changes in particular and innovation in general at the hospital. These are the age of the doctors in the hospital and reactions to a recent organisational crisis and the threat of new crises.

Age of Doctors

All interviewees commented on the relative youth of doctors:

“The attraction of younger staff to [the hospital] has given the opportunity to be more innovative and to be younger in its approach and to embrace change.” Academic

The Academic continued to comment that the hospital offers younger doctors opportunities that are not available in more established hospitals:

“They get to manage the patient themselves, and they get to see a wide variety of clinical cases, ... There aren’t five or six doctors trying to see the same patient.”
In exchange the hospital benefits from an increased willingness to try techniques from outside the boundaries of clinical practice.

**Recent crisis and perceptions of impending organisational crisis**

The impact of organisational was the second most prominent theme, behind pressure for change. A new General Manager and executive team arrived at the hospital after a public inquiry had found evidence of quality and safety problems at the organisation. The inquiry has had a lasting impact on the staff and the local community has not forgotten either, as the Executive Manager revealed:

"Yesterday, I got an acknowledgement letter that says, "You hear about all the crap at [the hospital]..." and it just makes me feel sick when I read it, you know it was five years ago now and we're still hearing it. But it means that people are open and wanting to make some change."

While traumatic, the Academic considered the public inquiry did provide an ‘un-freezing event’ (Lewin, 1951) providing hospital members with flexibility to question, and pressure to change operating procedures:

“If the landscape is like a moon landscape, which it was after the inquiry, you couldn’t make it any worse, it was the perfect place for making changes.”

The experience of a hostile, external review continues to make the hospital members willing to work together to avoid further inspection. The reaction to recent threat of an external review and being directed what to do by AHS personnel for not meeting one performance target resulted in rapid change, supported across occupations in the hospital:

“... everyone got the fear of God in them. They said “We don’t want a review team!” Everyone basically dropped a few other agendas and got this on their agenda. But what’s been interesting with the process is we’ve been able to sustain it, and we can because I think the structures and the processes got put in place very quickly and we have been able to sustain it.”

Executive Manager
The Executive Manager also described how attributes of clinicians’ training and socialisation were used to elicit support in avoiding the AHS review:

“The Director of Medical Services came up with a weekly report that looked at [the target] by dept. ‘Cause she said that clinicians love data and they like competition. That’s what we did and literally in a month, we had turned it around.”

These results support and extend the factors influencing DoI in health settings derived by Greenhalgh et al. (2004). The factors prominent in the diffusion of the innovation studies are now discussed in relation to evidence based management and change management techniques.

**Discussion**

This paper has analysed organisational factors influencing the diffusion of a process innovation from manufacturing to a public hospital setting. The evidence suggests Greenhalgh’s et al’s 2004 DoI model, is comprehensive, and applicable in Australian public hospitals, but not exhaustive. It may be impossible to produce a truly exhaustive model due to the unique interaction between each health organisation and its environment. Indeed Greenhalgh et al. note that their findings should be seen as “illuminating the problem and raising areas to consider” rather than “providing definitive answers” (2004: 612 - 613).

Public sector organisations have been identified as particularly prone to the ‘Not Invented Here’ syndrome (van Duivenboden & Thaens, 2008), hindering opportunities to learn from other industries and organisations. This was not observed or reported at the hospital. Inter-organisational networks and leadership styles contributed to reducing insularity in the hospital and increasing absorptive capacity. Leaders were seen as innovation champions who assisted in propagating improvement initiatives.
Nembhard et al. (2009) recommend that staff experiment with innovations in ways where failures have little consequence for patients to overcome innovation resistance in health organisations. In addition, they identify leaders who make collective goals more compelling than individual goals and who promote open dialogue as contributing to successful innovation implementation. As described in this paper, attributes of computer simulation and leadership of the hospital match these conditions and have played a role in the hospital’s early adopter status.

The age of clinical cohorts and the proximity of real or perceived organisational crises had a definite impact on the hospital’s receptiveness towards innovations from outside the heath sector and willingness to implement them. The influence of clinician age on innovation acceptance has been reported recently (Scott, et al., 2008). It is possible that the six years since Greenhalgh et al’s meta-analysis represent a period of significant change in the health services landscape. Generational changes in clinician training, combined with an increased acceptance of the need to improve upon traditional hospital practice due to demographic and fiscal forces, may have produced a more receptive context for innovation and change in other NSW hospitals, just as they have in the hospital studied in this paper.

**Strengths and Limitations of the Study**

Methodological limitations associated with this study include the limited lifespan and generalisability of qualitative research findings, coupled with the small and purposive interview sample. Additionally, the sonography scheduling project was conducted during a period of comprehensive and rapid change in the Emergency Department. It is unclear if simultaneous changes increase or reduce organisational acceptance of lean thinking and computer simulation of process innovations. However as the objective of the paper was to focus on factors influencing innovation at a specific hospital at a particular point in time, qualitative methods are most appropriate for the study.
The study explicitly embodies elements recommended for the “next generation of health service innovations” (Greenhalgh et al., 2004: 615 - 616). It is process oriented, recognises the reciprocal interaction between the innovation and the setting in which it occurs and is participatory. While this paper provides the macro view of DoI in the hospital, with an emphasis upon the views of organisational elites, it is strengthened and complemented by the simultaneous work performed to analyse group and individual factors that influence DoI at the hospital (Eljiz et al., 2010a; Eljiz et al., 2010b).

**Directions for Future Research**

Fruitful avenues for future research include using computer simulation to generate and model potentially productive changes in other departments. Furthermore, this paper considers organisational factors influencing DoI from manufacturing to health settings, but does not focus on the DoI process. Research tracking the DoI process to see if the importance of different organisational factors remains fluctuates over time may make useful contributions to knowledge and practice.

All informants emphasised the vital importance of working in partnership with clinicians to effect change, and the challenges professional autonomy can present to health innovation implementation. An incident successfully using of clinicians’ preferences for quantitative evidence to support process change is described in the results section. Investigating the impact of education about statistical methods employed in Lean thinking and computer simulation to encourage clinician engagement may be another interesting avenue for research.

Finally, anecdotal reports claim sonographers working in private practice have double the patient throughput of sonographers in public hospital imaging departments. Analysing and comparing the processes of public and private imaging services may provide valuable insights to improve public hospital processes. Process comparisons may also illustrate performance limits when the majority of patients are emergency cases, as managing the
high proportion of unscheduled emergency cases is one of the key challenges for the imaging department at the hospital.

This paper addresses an important gap in theoretical and practical knowledge by examining the organisational factors that predispose a public hospital to adopt process innovations originating outside the health sector. Process innovations originating in manufacturing settings can be adapted to health services settings and have potential to ameliorate some of the pressures operating in health services settings.
References


