Incorporating Practitioner Based Enquiry Into Software Development Research

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INCORPORATING PRACTITIONER BASED ENQUIRY INTO SOFTWARE DEVELOPMENT RESEARCH

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Abstract

This paper describes a research model, known as Practitioner Based Enquiry (PBE), now being used in academic disciplines exploring the creative industries. We propose that it would form a useful additional methodology in the arsenal of ICT researchers. It allows the research process to penetrate the privacy of the office cubicle to uncover what software developers actually do rather than what they say they do, or what they may recall a week later in a survey or interview setting. PBE provides not only a new approach to examine the software development process, it also provides a research model that may be particularly relevant to post-graduate research students who wish to complete a project whilst engaged with an industry partner or their current employer. It is also a research model that may provide results that are more directly relevant to industry partners. Consequently it may be relevant to many universities seeking to address the challenges of attracting good research students and engaging in industry relevant research projects.

Keywords: PBE, Research Methodologies, Postgraduate Research.
1 INTRODUCTION

The evolutionary development of the ICT sector from disciplines in engineering and technology has tended to focus the project management models and development methodologies on an engineering model. This is the origin of the requirements engineering initiatives, and the long standing debate within the sector of how to extract requirements from users/clients; what level of detail should specifications be locked to user requests; and the evolution of prototyping methodologies to cope with the fluidity of the user environment.

At the same time it is one that is commonly conducted in a team setting and to budget and delivery constraints that have imposed the need for an organisation of that process. The result has been the growth of methodologies for development (Avison and Fitzgerald 2006). The plethora of methodologies that have been developed allowed Olle (Olle and al 1991) to produce a catalogue that reflected the variety of pathways humans can find to similar solutions. More recently the dominance of a few methodologies of the marketplace reveals how organisations have sought comfort in established franchises that their contemporaries are depending on.

While some earlier writers identified the creative process embedded in software design (Brookes 1987), in recent years the need to engage users to use a system in a competitive online marketplace have erased the certainties that existed with developing transaction processing systems on a mainframe system distant from customers. The environment for much development now is less analogous to designing a car than producing a movie. Software development has joined the other more established creative industries. This is not just in the obvious segment of gaming but even transaction processing systems such as online banking have had to similarly engage an audience. Conventional creative industry projects range from the solo author writing to a publication deadline or a painter completing works in time for an exhibition timeslot in a gallery; through to multi-million dollar movie projects with hundreds of collaborators. The stereotype of creative decision making belonging to a lone novelist or painter ignores the reality of the commercial arts industry. Budgets and timelines in the commercial creative media can be as hard and challenging as in any software environment. The project teams and project planning used in major software projects are more than matched by the large teams of collaborators and project management challenges of producing a feature film. Whilst many key creative decisions are made by the writer or director, there are also a plethora of decisions made by those engaged in costume design, set design, and every step in the complex trail through the post-production studios.

This paper examines a research model that has developed in the creative industries but which we propose has relevance to the ICT disciplines.

2 PRACTITIONER BASED ENQUIRY

Practitioner Based Enquiry (PBE) has evolved in the context of what would be commonly recognised as creative projects in the arts and media. However it is not based on romantic notions of creativity but rather on a systems model of creativity derived from work by Pierre Bourdieu (Bourdieu 1977; Bourdieu 1993; Bourdieu 1996) and Mihaly Csikszentmihalyi (Csikszentmihalyi 1988; Csikszentmihalyi 1997; Csikszentmihalyi 1999) who argues:

“for creativity to occur, a set of rules and practices must be transmitted from the domain to the individual. The individual must then produce a novel variation in the content of the domain. The variation must be selected by the field for inclusion in the domain” (Csikszentmihalyi,1999,p.315)

Where here the domain is a structured knowledge system the person must access; the field is constituted by all those who can affect the structure of the domain; and the person, who makes decisions about how to rearrange aspects of the domain into something unique, is encultured into the domain and socialised into the field. ‘Instead of looking at the separate elements in the creative
process Csikszentmihalyi expounds an idea of creativity [that] can be studied by investigating moments within it’ (McIntyre 2006), p3. In the ICT development context the researcher can investigate how a person acquires knowledge of the domain and how this affects their ability to make decisions during the design and construction processes. This can take the form of survey approaches or more recently it has been common to undertake ethnographic studies. The PBE approach proposed here provides another approach from a constructionist epistemology (Blaikie 1993; Crotty 1998; Grix 2004). Constructionism lies between objectivism and subjectivism in accepting ‘the existence of a material world but argues that it can only ever be accessed through constructions of it’ (McIntyre 2006), p10. As such PBE sits inside the phenomenological tradition seen as an “intentional analysis of everyday life from the standpoint of the person who is living it” (Griffin 2000). A PBE research methodology includes the techniques of the process of making the object, the keeping of field notes in the form of a journal and an examination of the artefact itself. This process provides a raw insider’s perspective of the process without such filters as the efflux of time or the interpretation of questions.

‘PBE as a methodology encompasses a self-reflexive and reflective examination of the practitioner’s own activity through a process of participation in that activity’ (McIntyre 2006), p4, such that they ‘enquire into their own practices to produce assessable reports and artefacts’ (Murray and Lawrence 200), p10. The PBE researcher must be self-reflective or self-reflective. Self-reflexivity is described by Sullivan as a form of investigative practice that:

describes and inquiry process that is directed by personal interest and creative insight, yet is informed by discipline knowledge and research expertise. This requires a transparent understanding of the field, which means that an individual can “see through” existing data, texts, and contexts so as to open to alternative conceptions and imaginative options.’ (Sullivan 2004) p.64-65

Bolton makes a distinction between being reflexive and being reflective. She argues that reflexive activity is focused on oneself and reflective activity looks further afield at other people, the situation one is in and the place one is involved with. She then goes on to state that ‘reflective practice is a process of learning and developing through examining our own practice, opening our practice to scrutiny by others, and studying texts from the wider sphere’ (Bolton 2001), p.4. Such observation of self fits with the widely used observation of participants that has formed the lengthy tradition in anthropology in the form of ethnography. This has been translated into the domain of information systems and has drawn on the embedded nature of ethnography to distinguish it from the external observer nature of ‘case study’ research.

The accumulated observations are recorded in the journal which provides evidence that the research has taken place but also provides an ordered source of systematic data for the analysis in the written exegesis or other publication form. The journal and exegesis sit beside the created object to elaborate the processes that lead to its creation. Self-reflection is not without its limitations. It does not have the sample size of a survey or the multitude of perspectives that may be described in ethnographic or case study research. Zuzanek discussed some of the difficulties and limitations in PBE such as: under or over reporting of certain activities; the researcher’s ability to codify their own activities; the difficulty of recording simultaneous and concurrent daily activities; the influence of the subject researcher’s own cognitive nets on pattern-seeing; and the study’s ability to definitively establish the grounds for casual links between daily activity and creative output. (Zuzanek 2004) However many of the possible criticisms of PBE are not only based in an objectivist epistemological framework but also apply to other research practices that rely on subject recall and researcher formulations of questions in traditional survey and ethnographic research.

The advantages of PBE include the revelation of an ‘insider’ perspective that may be constrained in other research approaches. This provides an additional perspective to the other research methods on the processes that contribute to the creative production of a wide variety of creative objects that can include software products.
2.1 Principles Embedded in a PBE-ICT Research Model

In order to articulate a PBE Research Model we can identify the following principles as underlying a PBE research approach.

1 – Principle that research questions are raised by the production of ICT artefacts.

PBE assumes that there is knowledge and understanding to be explored in the way practitioners use their skills in any given domain to produce artefacts. The consequence is that the production process raises questions independent of the usage of the objects themselves. This means that various methodologies that may be used to develop similar ICT products will each raise research questions that may or may not be distinct for the production pathway and skills used in that process of production. Thus the research outcome may vary with the tools used by different teams of developers. However, equally the existing skills and level of expertise of the developer will have an impact on the production pathway and outcome, with each combination having the potential to raise interesting research questions.

2 – Principle that in IS new ground is being broken in practice.

IS, and the ICT sector more broadly, have always been domains of scholarship where the developments in academic research have had a constant interplay with commercial practice and commercial research and development. However, it is not just in the development laboratories of the major software or hardware corporations that new developments and trends are being forged. Unlike the pharmaceutical industry where new product development is restricted to major manufacturers or research laboratories, new ground in IS development and practice can be occurring in the IT department of the local department store or small manufacturer. This has been recognised in the variety of locations for case study research over many years.

3 – Principle of recognizing the practitioner skills possessed by researchers.

PBE relies on the researcher having skills related to the practice of their discipline. PBE uses the skills of the researcher within their domain of practice as well as their research skills. The consequence of this principle is that the researcher needs to be a practitioner as well as a researcher and there is an inherent constraint on the range of topics for possible research within the range of experience of the researcher. This constraint does not require that the researcher necessarily is an expert level practitioner in the domain but it does mean that entry into an area of research requires some existing experience or the participation in some form of training or relevant skills acquisition. In addition the nature of PBE as a research process can also be aimed at increasing the level of skill of the practitioner and as such provides the ground for further research into the characteristics of this development.

4 – Principle that practitioners are closer to recognition of some issues in their own practice.

Whilst there is an obvious and established advantage for the external impartial observer to comment and analyse questions of practice, PBE recognizes that the practitioner has the possibility of contributing unique insights into their own practice that then may be generalised theoretically rather than statistically. This approach can also be expected to produce research questions not obvious to an external observer who may have a range of research skills but may overlook opportunities.

2.2 PBE in Relation to Other Research Models

In all this discussion we do not propose PBE as a substitute for other research models but rather as an additional tool to obtain otherwise difficult to source perspectives on the practice of IS developers. PBE can be considered at the qualitative end of a spectrum of research approaches and will complement the knowledge derived from both quantitative and qualitative forms. PBE can also utilise the principles of other methodologies that involve participation, such as auto-ethnography, or aspects of participatory action research. The key difference is that the researcher is not participating in an attempt to engage with a community being researched or to gain greater insight by sharing in the
experiences of that community, rather (as described in the principles above) the PBE researcher is principally drawing on their own skills and activities to drive their research and at the same time learn something about the development of those skills. The participation in a development team may result in the exploration of the impact of group activities or team management on the outcomes of their development activities. However, the starting point for the research and consequently the framing of research questions to be explored is focused in part on the activities of the researcher in using an existing skill set and improving on those through practice.

2.3 Evaluation of PBE-ICT Research Outcomes

Just as for the outputs of conventional research projects, one of the key parameters for evaluation of a PBE project is the originality of the conclusions drawn from the research. To evaluate the effectiveness of the project as an exercise in PBE then the principles above can provide some guidance. From the principles above

- the subject of the project should be centred on the production of some software or hardware artefact;
- the research should be examining questions relating to new practices in development;
- the research outcome should reflect the nature and extent of the practitioner skill set of the researcher; and
- the research outcomes should reflect on contemporary practice in software or hardware development or production. For example, whilst research results may be uncovered about the social impact of a particular software artefact, this should be a by-product of the project and the central outcome should be on the practices of the researcher which engaged in development.
- the research outcomes should also reflect and be situated within and against the pre-existing literature on IS.

3 PRACTICE AND THEORY IN ICT DEVELOPMENT

The ICT sector has long had knowledge domains that new practitioners must gain an understanding before they can join the field of experts in that domain. However discussion of these domains has often revolved around the technical details of technologies required into producing a software or hardware product. Where the understanding of the domains has tended to reach its limit is in the creative decisions between technically equivalent alternatives. This is reflected in the lack of detail in guidelines on the apparently simple decision on partitioning systems into sub-systems. The usefulness for good project management of partitioning large systems into component sub-systems has been recognised in the ICT disciplines since the early days of computing. However, the guidelines in methodologies, textbooks and research publications have been ambiguous, vague or absent. This has long been an example of where the skill, intuition, experience and creativity of the software practitioner has guided them in the choices they make. Similar areas of design choice have increasingly appeared at all stages of the development process. In discussing theories of design Gregor & Jones comment:

‘Design activities include elements of creativity and imagination. Given many components for a system, all of which could be combined in a myriad of ways, all theoretically sound, an experienced designer will likely employ some “art” in transforming the components into a novel and workable system. Simon’s work is influenced by the notion that design is a creative activity and, therefore, may not be able to rely on existing theory. The question remains open as to whether “science” is an appropriate word to apply to IS design theory, given the degree of creativity involved.’ (Gregor and Jones 2007) p 331.
If there ever was the possibility of applying a mechanical design response to a requirements specification then this has evaporated in response to the need for the majority of applications to be innovative and creative in a way in which they engage their users against competitive alternate software. The plethora of competitive software to achieve set requirements or to gain the attention of the user in the marketplace of the web or mobile applications has forced all applications developers to seek creative solutions that engage the user as well as achieve other more technical or functional design goals. Despite the rise of this competitive pressure in the marketplace there has been more limited attention to creativity in the research literature in IS. (Shneiderman 2000) discussed the range of approaches to creativity relevant to IS, including the Systems Model referred to in this paper, but just in the context of user interface design. The development of graphical interfaces has fuelled the production of many HCI guidelines based on psychological and usability studies. However, in parallel with these rigorous studies, the graphical designers have evolved the creative domain they were using in printed material to construct online interfaces that break many of the psychologically researched rules yet engage customers to produce the outcome all developers are seeking. The identification of creative activity in the HCI domain is the tip of the iceberg of creativity underlying successful information systems.

4 RELATING PBE TO ICT

In this section we will outline how a PBE project may be conducted in an ICT environment. Given the nature of PBE there is a distinct opportunity to use this approach with post-graduate research students to provide not only an additional methodological technique but one that is particularly suited for the diverse needs and interests of a growing number of part-time research students. For academic departments it provides a new model for partnership with industry that places less demand on the industry partner than much existing research that is strongly dependent on government funding. An obvious reservation that has been expressed in relation to PBE is that it does not produce results that can be replicated, however, as (Tate and Evermann 2010) note, there is rarely replication of conventional studies in the IS literature. However, replication is a hallmark attribute of a research methodology that complies with an objectivist framework and while PBE can't provide the basis for a statistical generalisation as a result, it can nonetheless provide the basis for theoretical generalisations.

4.1 Structure of an ICT PBE Project

A PBE project involves a researcher/practitioner engaging in a task and maintaining records of observations and reflections about the process they are engaged in. Thus in an ICT PBE, the researcher could be working alone or in a team and engaged in any aspect of the industry. In any PBE project the important tool is maintaining a concurrent journal and on conclusion or periodically during the project, examining, reflecting and analysing the consequences of these observations. The final product will be a journal record with an analytical document that identifies the lessons drawn from this experience for the rest of the industry. This concluding analysis/exegesis will include reflections on the end product of the process, whether it be a software product or design documentation. This process shares some characteristics with Action Research such as the direct participation of the researcher in activities in the community being researched, however, it is not focussed on a feedback loop of improvement that is central to Action Research and it is focussed on the experience and activities of the researcher in the project rather than necessarily as part of a team working to improve their group performance. Examples of projects could include:

1. A solo researcher using a software development environment to build a software application. The outcome could be insights into the true usefulness of elements of the software tools. Which of the debugging utilities provide useful information? What is the assistance that the developer really needs from the associated ‘Help’ facilities?

2. The researcher is working in a larger team using a system development methodology. The outcome could be insights into the obstacles to effective functioning of the team. Which
elements of the development methodology were truly useful in clarifying or making design decisions? Which elements of the methodology were useful in the design process and which ones were conducted merely to complete a mandated step in the process or were favourites of certain individuals in the team but lacked wider applicability?

3. The researcher engages in a software maintenance role within a large organization. The task of maintenance has perhaps been under-researched and yet it spans the largest phase of an application system’s lifecycle. A PBE exploration could identify the key sources of information and background knowledge useful in uncovering how a system operates and how its behaviour can be correctly modified or corrected.

4.2 Relating PBE to ICT Research

PBE can be incorporated into ICT research in a similar fashion to how it has assisted other disciplines by giving insight into the creative and skill based processes of system development. A significant body of literature has developed from surveying developers, interviewing them and observing them in practice. While these have provided useful insights, they cannot examine the internal thoughts and reflections of the developer or user while they engage with a software product or a development tool. Asking employees to complete a survey or comment to a researcher on their compliance with the protocols and methods used in their organization’s development methodology may not reflect the truth. Provision of information to a third party has a number of possible constraints for respondents to surveys.

The first constraint is the challenge of memory. Recalling the actions and issues that confronted a subject days or weeks prior to a survey or interview may confound or flatten the results. By contrast with PBE, while the same methodological critique can be applied, in this case the subject is the researcher who has the motivation and a commitment to record their observations from using a technology or methodology with more immediacy and regularity.

Despite whatever assurances can be given of confidentiality for a survey protocol, users have increasing experience with surveys that is giving them a more sophisticated response to the process. In addition to reservations about the true confidentiality of a particular research protocol, experience and cynicism about surveys can lead to respondents targeting their answers not to the truth but to the outcome they wish to encourage. At its most benign, enthusiasts for a software tool or methodology may exaggerate their usage and compliance; whilst reluctant users may underplay their usage of it. Zannier comments that it is difficult to discern between what people say from what they actually do. (Zannier, Chiasson et al. 2007) Both of these forces can be seen to cancel each other out within a large sample size but they contribute to a clouding of the examination of any given development process. PBE provides a framework for an individual researcher to document their detailed usage of a protocol or process with any agenda being explicitly articulated in the analysis of their reflections.

It is important to note that the results and observations from a PBE exercise are not meant to replace other research methods but simply to add to the suite of tools available to the IS researcher. Just as qualitative interview methods have provided elaboration of the data provided by quantitative surveys, the PBE approach adds to the toolkit available to researchers.

4.3 Post-Graduate Research Projects

The challenge for many university departments is in recruiting students into research degrees, both at masters and doctoral levels. The pressures against recruitment of students have included the opportunity cost of study in the light of commercial salaries, the lack of recognition of research degrees for their relevance to non-academic employers in the ICT sector, and the difficulty of connecting their research project with industry practice. This disconnect between research and practice has been debated from many perspectives. From the computer science approach it is often argued that the research projects contribute to new or improved fundamentals to the technology used by the
industry; whilst the information systems tradition has been dominated by survey or interview based research on how products or processes are being used. Neither approach may be suitable for a person with industry experience and who wishes to leverage directly off that expertise. Into this mix must be incorporated government desires and financial initiatives to bring industry and academia closer together. (Winter, Griffiths et al. 2000) note this public funding pressure on higher education but also note the broadening in the range of people undertaking higher education and who thus see Research Higher Degrees (RHDs) as not just a pathway to an academic career. They also note the range of positions as to what should count as “knowledge” and the prospects for “generalizing” from knowledge gained in particular contexts of practice. While addressing these gaps is a challenge it is important that it be met if the community imperative to bring industry practice and research together for the economic returns sought by the community in higher education funding.

If students do not have an existing ambition to become a researcher then on graduation from their undergraduate program the attractions of careers in industry can be very strong. Within the Australia ICT sector there has been a skills shortage for a number of years. The brightest students that university staff may wish to attract into a doctoral pathway will be offered far more attractive salary packages with commercial organisations. However it is not merely in the remuneration (for which university’s have always lagged behind industry) that may be of appeal, but much of the leading edge R&D is being conducted in commercial organisations. In addition the large corporate players can offer opportunities to travel and work overseas that university research budgets are increasingly finding difficult to resource. Beyond the conditions of work and remuneration, the relevance of much university research can be questionable to the young post-graduate student. If a research project is not jointly funded by a commercial partner then university departments may not have access to the latest technology being used by industry. For most information systems research the relevance to current practice is critical to any opportunity for the research to be incorporated into existing commercial activities. This can be important for research students who wish to use the outputs of their research degree as an entree into the commercial world.

A growing dynamic in Australian universities has been the rising numbers of part-time students enrolling in PhD programs. This phenomenon is appearing in many disciplines but particularly in the humanities and social sciences. It appears to be happening less in the natural sciences due to the requirements for expensive consumable and fixed resources which constrain any research to only be viable if substantial grant funding is in place. However, the enthusiasm for engaging in a research degree is increasing among professionals who have reached a certain level in their careers and wish to do something more creative and stimulating than a course-work masters program.

The nature of ICT research projects has been evolving since the introduction of computers into universities. The various disciplines under the ICT banner have always been dependant on the commercial ICT sector. The direction of the technology has been driven by the economic realities of the industry, with academic research projects providing insights to enhance and progress the technology. An example of this link can be seen in early university projects to examine optimisation of disk drive management because disk drives have until recently been the appropriate economic choice as the mass storage technology. The range of research methodologies has expanded from those early algorithm development exercises to include a range of quantitative and qualitative techniques. This paper is advocating an additional technique for that catalogue.

A PBE project for post-graduate researchers in ICT offers the following attractions:

- It can be done using current professional practice and technologies and so throw light onto their effective usage;
- It can be engaged in by a part-time student in the context of their current professional life and practice using the technologies in their workplace;
• Its currency to current practice and technology can provide immediate feedback and results relevant to industry and in particular for part-time students it could be of benefit to their current employer;

• For part-time students the ability to combine their research project with their current professional practice may reduce the stress of juggling a PhD with daily employment;

• For part-time students it enables them to leverage their existing skills and environment to their own and perhaps their employers benefit;

• For students conducting a PBE project either from professional practice or concurrently with professional employment then they can provide an insider rather than observer commentary on current practice;

• For part-time students in existing professional practice it could avoid the need for provision of substantial equipment infrastructure;

• For full time students who have just graduated from an undergraduate program then this allows them to combine the development of research experience with gaining experience with using current technologies or practices;

• It avoids the not insignificant challenges of recruiting significant numbers of subjects for survey based research;

• It provides the possibility of enhanced industry collaborations if they see the possibility of insights being gained of direct relevance to their products or practices;

• The approach is relevant to projects examining any phase or the development process and any activity within professional practice;

• The approach is suitable for individuals involved in any role within ICT development from programmers, network administrators, database administrators, technical writers, project managers, etc.

In summary, a PBE research project may allow a student to continue development work in an area of his existing experience or for part-time students to allow them to use their existing work environment as the platform for a research project. It is in this context that the opportunity for relevance to student interest may be highlighted. Many individuals attracted to ICT are interested in the design and construction of new software products and less interested in exploring the theory behind the technology or the outcomes of its use. The PBE approach in the ICT sector allows these individuals to explore the process they are most interested in and produce a software artefact and insights into its design and construction.

4.4 Challenges to Implementation

The use of PBE in an ICT research environment faces challenges that have been experienced by other research methodologies. Quantitative methodologies were not championed by researchers used to algorithm development, until they realised that various experimental validations would enhance the justification for using a particular practice or technology. Similarly qualitative methods have had to argue and defend their relevance and accuracy from quantitative researchers but are now common foundation methodologies. Such has been the acceptance of these approaches that it is now not uncommon to use a research methodology of triangulation that draws on all three of the above to strengthen the conclusions of the research project.

PBE has faced similar issues of acceptance in other disciplines where it has been introduced and it is by no means widely accepted by various academic communities. The primary challenge to introducing PBE to ICT research is gaining acceptance by the community or a significant enough proportion to support the acceptance of PBE based research by editors and conference program committees.
5 CONCLUSION

The Practitioner Based Enquiry model for ICT research presented in this paper is an approach growing in use among creative professions. It provides a model for new avenues of research in the ICT sector that can provide insights that may not be gained by existing survey, observational or interview techniques. PBE also provides a research model suitable to many postgraduate students and industry partners that combines research outcomes with clear commercial productivity. The IS academic community has learnt much by adopting and refining research models from the social sciences. Creative industries research is a field that is still establishing itself in the academic community but it is not too early for the IS community to learn from their research methods and expand our own set of available research tools.

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