WEB-BASED INFORMATION SYSTEMS THEORY FOR EMERGENT HIGHER EDUCATION ORGANISATIONS

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Abstract

This paper considers appropriate theories in developing web-based information systems from an emergent higher education organisation context. It postulates that web developers need good design and action theories for cumulative building of knowledge. The theory of deferred action is used as an appropriate theory for developing web-based information systems. Many of the available design and action theories within information systems are not able to explain the phenomenon of emergence. The insights proposed are believed to assist academics and practitioners in identifying the theory of deferred action as a suitable theory for web-based information system development.

Keywords: web-based information system, emergent organisations, information systems theory, theory of deferred action

1 INTRODUCTION: SYSTEMISE KNOWLEDGE WITH THEORY

In order to systemise knowledge of how to develop web-based information systems (WBIS) a good theory is needed for cumulatively building knowledge, as this demonstrates what is known or agreed and also points to directions where further work is required. The often quoted dictum of Kurt Lewin in 1945 that “nothing is so practical as a good theory” remains relevant today. Without theory, there is greater risk that research studies become more fragmented and inconsistent. Theory provides researchers with a better starting point. In Dwivedi et al (2009) Dale Goodhue describes it, “a theory is ‘a stool’ that you stand on to get a better view”. This emphasis on providing justification on using a suitable theory to inform practice within an emergent organisation is the aim of this research paper.

2 EMERGENT HIGHER EDUCATION ORGANISATION

Emergent organisation is ‘a theory of social organisation that does not assume that stable structures underpin organisations’ (Truex, Baskerville & Klien, 1999). This is due to the rapid development of commercial technology and re-engineering within the environment, which give rise to a recognition
that organisations are continuously adapting to their shifting environment. Truex, Baskerville & Klien, (1999) described these type of continuously changing organisation as “constantly seeking stability, while never achieving it”. Truex, Baskerville & Klien (1999) summarise this notion as being “emergent”. Bello (2002) agrees that the notions of “emergent” organisations are those that are in continuous evolution and transformation.

Developing web-based information systems (WBIS) on a static definition of requirements is problematic in an emergent organisation. Emergent organisations are evolving dynamically in a process of continuous transformation. This can lead to a disproportionate, rigid, uncomfortable format that makes it difficult to move and adapt to the changing environment. Explaining why an organisation is termed “emergent” and categorising it as being unstable and in continuous change, gives rise to the question of what dilemmas emergent organisations encounter.

There has been work where emergent technologies have been studied empirically in the field studies of the intranet and Web-based development (Bansler et al 2000; Balasubramanian and Bashian 1998), although they do not address the theoretical problem of selecting an appropriate theory in an emergent organisation. Bansler et al (2000) calls for further studies extending over a longer period of time.

Truex and Baskerville (1998) suggest that in an environment of continual change, Information System Development (ISD) strives to achieve goals of continuous re-development, continual change, dynamic requirements negotiation and incomplete or purposefully ambiguous specifications. Emergent characteristics stem from the struggles and negotiations inherent in the socio-technical context of the system within the organisation. It emerges as different individuals and actors react to WBIS in different and possibly conflicting ways that best correspond with their own needs i.e. a set of uncoordinated reactions. Further, the research paper justifies the selection of an appropriate theory to inform WBIS together with an action research investigation (Ramrattan and Patel, 2009).

3 BRUNEL UNIVERSITY STUDENT SERVICES & ACTION RESEARCH

The paper reports on an action research investigation which utilised two different studies from Brunel University. These two studies are highlighted in 2.1 and 2.2. Both studies needed the adoption of an appropriate theory to aid the web developer during the WBIS development process.

3.1 Brunel University Student Services (First Study)

The relationship with Brunel University Student Services (SS) section started through the advertisement of a Web Developer role in developing WBIS. Within that relationship, the Web Developer and Manager began to explore what methods, methodologies and tools can be used to improve the current WBIS already in place. The project undertaken reports on an action research investigation that spanned two years and involves the development of two main WBIS projects. These Web-based Student Services has had to ultimately provide continuously better support for students each year, which is dynamic and problematic when mixes with organisational change.

At Brunel University, the Student Services section has increasingly changing regulations. In one instance, the University wants to provide continuously better support to the students which involve the development of a Student Services WBIS, wherein many different services are collectively incorporated. How Brunel University Student Services section creates this whilst, at the same time, managing organisational change, together with fast pace deadlines and delivering media features is a
problem that is situated in both theory and practice (Baskerville et al, 2007; Kautz et al, 2007). Having the Web Developer is placed at the forefront of the development process, which lends itself to justifying the selection of an appropriate theory in the context of dynamic organisational change.

3.2 Student and Research Handbook (Second Study)

The Student and Research Handbook (SRH) are made available as online resource material for all Undergraduate (UG) and Postgraduate Research (PGR) students at Brunel University. There are two separate links, with overlapping content pages, which are available for students to access via the Brunel University intranet sites. Students and staff can access this content on campus and from home. The content of the SRH handbook includes admissions policies, registration policies, fee information, concerns or complaints, copyright of your research, annual monitoring report, etc. The SRH covers a broad range of aspects surrounding what a student might encounter whilst studying at Brunel University.

The Brunel graduate school had commissioned the development of an improved SRH WBIS. This initiative involved conducting interviews and card sorting tests. The investigation resulted in a list of recommended changes for the web developer to implement. The web developer conducted the development of the SRH. The theory of deferred action was used in the development of the SRH WBIS. This enabled the web developer to more accurately understand the emergent changes throughout the WBIS development process. The action research investigation gave added rigour to the use of appropriate theory in an emergent organisation.

3.3 Action Research Methodology

The investigation used an appropriate research methodology to learn about the actual and situated practice of WBIS development through first-hand experience, as it is critical to the development of applicable knowledge. This criticality once incorporated helps to draw on theory, gain feedback, modify theory to practice and test it iteratively. Using this type of investigative methodology, new insights can be gained into understanding the problem in its context and creating applicable solutions.

Action research methodology was used to gain insights into how the web developer develops WBIS. Coghlan and McDonagh (2001) suggest that action research methodology confronts major dilemmas facing emergent organisations. Specifically, this relates to integrating information technology into continuous changing organisations and can make major contribution to their resolution. The research looked to help web developers understand and develop solutions for environments where emergent organisational change are prominent. The research utilised existing emergent theory to provide the foundation needed to investigate the phenomenon.

The action research methodology is designed to fit both the organisational setting and the objective of the research (Coghlan and McAuliffe, 2003). Four main types of research data were collected and compiled in connection with the development of the student services WBIS: AR Cycles, emails, work documents and semi-structured interviews.

In action research, it is common to combine data collection techniques. These qualitative techniques are documenting action research cycles and conducting semi-structured interviews. The AR cycles revealed details on the meaning behind the action researcher’s findings rather than merely generating statistics. These data collection techniques were applied to accomplish the research objective. The
research objective is to develop analytical development tool to aid the web developer. These data collection techniques were applied to the student services and student research handbook WBIS projects.

The action research cycles placed emphasis on self reflection. This allowed the action researcher to write down what has been experienced, through reflecting, interpreting and tacking action. This process enabled the action researcher to reflect on what had been learnt and then comment on the significance of the results.

The qualitative data for the action researcher cycles consists of documenting the process encountered. The data collection adopts Coghlan and Brannick (2005) action research cycles as it composes of two different action research cycles. The first is diagnosing, planning, taking action and evaluating the data in relation to the project. The second cycle reflects on the action research cycle. This is done through continually inquiring into each of the four main steps of the cycles to improve the subsequent steps. The researchers Zuber-Skerritt and Perry (2002) identify this cycle as the ‘core’ and the ‘thesis’ part of doing action research.

3.4 Summary

The web developer had to carry out the development of these two different WBIS studies whilst selecting an appropriate theory for WBIS development in an emergent higher education organisation. The justification of an appropriate theory is presented in the forthcoming sections. Researchers have been debating how effective is IS theory to informing practice.

4 INFORMATION SYSTEM THEORIES FOR EMERGENT ORGANISATIONS

The IS discipline, like other research arenas, imports theoretical frameworks in understanding organisational information flow and the construction of organisational IS (Truex & Baskerville, 1998). Theory is necessary to inform the design and development of WBIS in and for emergent higher education organisations (Ramrattan & Patel, 2009). According to the Association for IS there are currently eighty-three theories in the IS domain as of May 2009 (AIS, 2009).

Hambrick (2007) emphasises the importance of theory in research because theory helps researchers to: “organise our thoughts, generate coherent explanations and improve our predictions”. Weick (1995) debates what makes a good theory and commented that researchers need theories that are relevant for their given context. Bacharach (1989) argues that the very essence of good theory is formed by constructs and their relationships. The importance of constructs and relationship to theory development appears to be widely accepted by both IS researchers and by those working in other disciplines. Adversely, Sutton and Straw (1995) argues about what theory is not and describes the need for sound explanations as opposed to purely development of constructs and relationships.

Gregor (2006) examined the structural nature of theory within 50 IS articles from March 2003 to June 2004. This research identified the essence of what theories are, all of which are interrelated, though none more significant than the other. The five different categorisations of theory are presented in Table 1 (Gregor, 2006).

<table>
<thead>
<tr>
<th>Theory Type</th>
<th>Distinguishing attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis</td>
<td>Says “what is”.</td>
</tr>
<tr>
<td></td>
<td>The theory does not extend beyond analysis and description. No causal relationships</td>
</tr>
</tbody>
</table>
among phenomena are specified and no predictions are made.

| Explanation | Says “what is”, “how”, “why”, “when”, “where”. The theory provides explanations but does not aim to predict with any precision. There are not testable propositions. |
| Prediction | Says “what is” and “what will be” The theory provides predictions and has testable propositions but does not have well-developed justificatory causal explanations. |
| Explanation and Prediction | Says “what is”, “how”, “why”, “when”, “where” and “what will be”. Provides predictions and have both testable propositions and causal explanations. |
| Design and Action | Says “how to do something” The theory gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artefact. |

Table 1. A Taxonomy of Theory type in IS Research (Gregor, 2006)

The advantage of identifying the different types of theory encourages practitioners and academics to clearly think about what type of knowledge is being generated.

The research focuses on theories for design and action which says “how to do something”. This type of theory emanates from Walls et al (1992) work which postulates that: the IS discipline needs to articulate and develop a class of “design theories” to aid the construction of IS. Design theories are prescriptive theories with theoretical underpinnings which say how a design process can be carried out. Utilising an applicable good theory can provide understanding and focus on addressing the problematic domain. However, in Dwivedi et al (2009) Dr Robert M Davison cautions researchers to pay particular attention to the process of selecting a theory for specific contextual use. He also advocates that researchers should evaluate the theories that may be more practical and useful or relevant for their given context.

5 THEORIES IN INFORMATION SYSTEMS

Dwivedi et al (2009) identifies seven strands of theory in IS. These strands are:

- Theory development and extension,
- Information System Development,
- Innovation, Adoption and Diffusion,
- Management Theories,
- Marketing Theories,
- Sociological and Cultural Theories
- Psychological and Behavioral Theories

These seven strands help the research investigation to clearly identify not just the nature of the theory, but in what context it is implemented. The research aligned with aiding WBIS in an emergent organisation, enables the researcher to clearly focus on the strand of theories within Information System Development.

Walls et al (1992) outlined a design theory of vigilant information systems (VIS) which is intended to provide rigorous and valid guidance to executive information systems (EIS) design. Though for the purposes of this research, the design theory of VIS doesn’t address the problem of how to rationally develop WBIS for emergent organisations. However, Walls et al (1992) does present an approach to
build and test design theories in the IS domain. This approach can be useful as a method for validating design theories. It postulates seven characteristics of a design theory, which are:

- Design theories must deal with goals as contingencies
- A design theory can never involve pure explanation or prediction
- Design theories are prescriptive
- Design theories are composite theories which encompass kernel theories from natural science
- While explanatory theories tell “what is”, Predictive theories tell “what will be”, and normative theories tell “what should be”, design theories tell “how to/because”
- Design theories show how explanatory, predictive or normative theories can be put to practical use.
- Design theories are theories of procedural rationality

Language Action Perspective (LAP) is an alternative foundation for analysing and designing effective IS. It provides guidance for researchers to gain understanding on how people use communication to coordinate their activities to achieve a common goal (Schoop, 2001). The close match between fundamental principles of Web services and the LAP approach suggests that researchers can use the LAP approach as a theoretical guidance to analyse and resolve Web service problems. The communication doesn’t address the rational of: how to develop in an emergent organisation.

Markus et al (2002) proposed a design theory for systems that support emergent knowledge processes. The design theory however, lacks good theoretical understanding of what is an IS. Distinguishing complex and simple IS is needed to clearly identify whether the theory is applicable to the context of research. Both organisation structure and resources is unpredictable because they operate in a constantly changing environment (Fieldman 2000; 2004). This research needs theory from an IS background that answers how to design IS that have no predetermined structure and function when such structure takes place in context. One such theory that addresses this problem is the Theory of Deferred Action (ToDA). ToDA is discussed next.

6 THEORY OF DEFERRED ACTION

The theory of deferred action explains the effect of emergence on the rational design of information systems (Dwivedi et al, 2009, pp.164). As a theory to inform practice it provides guidance in the form of design constructs on how to design rationally information systems for emergent organisation (Dwivedi et al, 2009, pp.164).

The purpose of the theory of deferred action is to facilitate the design of IT artefacts that will be used by individuals and organisations to act purposefully or to achieve objectives (AIS, 2010). The theory is used in IS as cited by Association for Information Systems (AIS, 2010).

Design theories for normal organisation exist but are borrowed from other disciplines (Walls, et al, 1992; Markus et al, 2002; Dwivedi et al, 2009, pp.164). The theory of deferred action enables the action researcher to overcome the lack of good theoretical understanding of information systems (Dwivedi et al, 2009, pp.165). The theory of deferred action is drawn from information systems discipline to inform practice and design for emergent organisation. It is a design and action theory which facilitates the development of IS & IT artefacts.
ToDA is based on complexity theory. Complexity theory is capable of informing practice. Its attributes incorporate the human dimension to advance and improve design quality. Complexity can be used to understand emergence in information systems and design processes. The key element of complexity is emergence, a constant “phase change” arising from emergence (Dwivedi et al, 2009, pp.166). Carlisle & McMillan (2006) state that emergence requires adaptive systems for IS.

ToDA proposes design principles that can be used to develop a basic research agenda on the concept of deferred design (Purao et al 2003). A deferred systems design is freezing the system until the user decides what the system will become over time (Patel 2002).

ToDA can be used to provide suitable design constructs and design processes for emergent organisations. These design constructs are planned action, emergence and deferred action. They are meta-design dimensions for designing informational and knowledge artefacts for emergent organisation (Dwivedi et al, 2009, pp.175).

Planned Action is organisational behaviour devised from some formalism, ‘it prescribes actual action as predetermined moves’ (Dwivedi et al, 2009 pp.175; Patel, 2006, pp.73). Therefore it assumes stable organisational structure and processes. For example, a three year strategic plan for a WBIS.

Emergence is ‘the occurrence of unplanned and unpredictable human events out of bounds of rational analysis and therefore off-design’ (Patel, 2006, pp.116). Emergence is the patterns that arise through interactions of people and WBIS within their environment. McMillan (2006, pp32) states that emergence is ‘the phenomenon of the process of evolving, of adapting and transforming spontaneously and intuitively to changing circumstances and finding new ways of being.’(McMillan, 2006, pp.32). There are no concrete IS examples as most are in the natural sciences (Dwivedi et al, 2009, pp.176).

Deferred action is the synthetic outcome of relating planned action and emergence. Deferred action is the synthesis of planned and situated action. It enables people to modify an IS within the context of its use. Deferred action relates current emergent action with planned action (Patel 2006, pp.96). Deferred action is the theoretical understanding of requirements for Web design (Patel, 2009). ToDA purposefully incorporates the mechanism Deferred action which enables growth of the design within actuality. Deferred action is a key mechanism of emergence on rational design. It enables the web developer (designer) to shape the WBIS in live context.

The relationships among these three constructs (planned action, emergence & deferred action) are illustrated in Figure 1.
Figure 1: Theory of Deferred Action (Source Patel, 2007)

The dimensions of planned action (rational design), emergence and deferred action are the three constructs of ToDA. These three constructs, when amalgamated result in different design models of reality. One example of this is depicting the implementable different system types: real systems, deferred systems and specified systems (Patel, 2007).

There are three model types which are real models, deferred models and static models of reality. Point A is real models. Real models of reality achieve near perfect replication between the model and the system. Point B is deferred models. Deferred models impose design structure on reality. It enables agents to shape the design to reality. Point C is static models. Static models are specified models of reality i.e. UML (Figure, 2). (Patel, 2007)

Real systems are designed in real-time by reflective designers. Real systems are not predetermined but designed during its use in actuality. A real system is enacted in the situation by active developers with the overall objective set as plans by reflective developers. (Dwivedi et al, 2009, pp.180)

Deferred systems is characterised by high emergence, high level of deferred action, and low capacity to plan system functionality and information needs centrally. It functions within its environment in response to emergent factors. Its functionality is not pre-specified but arises from the intentions of individuals or groups who interact with it in context. Therefore, a deferred system is deferred until the actor decides what the system will become. (Dwivedi et al, 2009, pp.178-179)

Specified systems is designed and shaped prior to IS development. It is assigned to specified development stages by reflective designers. Complete design knowledge is assumed as the start of the development process. Specified systems admit no emergence and assume high capability for specification design. (Dwivedi et al, 2009, pp.181)

The first dimension is planned action, which states that organisations plan. The second dimension is emergence, which explains the changing nature of organisations and its effect on the use of Information Technology (IT). The third dimension is deferred action, which is used to demonstrate
how action is taken by actors to overcome emergence in organisational context. This three dimensional analysis aids the web developer to understand the phenomenon of emergent organisation and WBIS development more accurately.

7 TODA APPLICABILITY TO PRACTICE

Three main exemplars of the ToDA applicability to practice are within the domains of legal arbitration, organisational learning and WBIS Development. Elliman and Eatock (2005) developed the online E-Arbitration-T system capable of handling workflow for any legal arbitration case (Patel, 2009). Elliman and Eatock (2005) project aimed to develop an online system for European Small Medium Enterprises (SMEs). It also sought to resolve disputes internationally. They applied the deferred design principle, to manage the open and changing system requirements and making their system an open system. This enabled users to make design choices rather than the system developer. Elliman and Eatock (2005) applied the deferred analysis, particularly the deferred design decisions principle, to manage the open and changing system requirements, making their system an open system. This enabled users to make design choices rather than the system developer. (Patel, 2009)

The deferred action construct is reflected in deferred learning systems. Dron (2005) invokes deferred systems to design systems that have ‘emergent structure’, allowing the system to have changing functionality. It is not designed from requirements but takes shape in response to the actions of the users. Dron (2005) developed a self-organised e-learning web-based system called CoFINd. Self organisation in CoFINd results in emergent structure which the system needs to reflect. It is not designed from requirements but takes shape in response to the actions of the people that use it. (Patel, 2009)

Ramrattan and Patel (2009) extended the ToDA by utilising the constructs of the generalised deferred realised autonomous specified systems (gDRASS) matrix and adapting them for the purpose of developing a WBIS development matrix (Kadar Matrix) that a web developer uses in actuality (emergent organisations).

Patel and Hackney’s (2008) work explains ToDA is used with empirical data on ISD in emergent organisation (Patel, 2002). The effect of emergence on knowledge work is observed empirically in Patel’s work (Patel, 2005). Further claim to support interventions in knowledge work requires further observation.

Patel & Hackney (2008) identifies emergence from general systems theory (GST) and systems thinking as a critical feature of systems analysis and design. There work notes that there is little theoretical understanding of emergence in systems analysis and design and no practical techniques to model emergence. They use the theory of deferred action based on the four dimensional analysis of their resultant constructs to enable systems analysis of emergence and its development for systems design. The scope for future development of the theory of deferred action is discussed next.

7.1 Future development of ToDA

Deeper empirical investigation is planned to test the effect of emergence on rational design (Dwivedi et al, 2009, pp.186). Data to validate deferment points is needed. Clearly define the operational principle of deferred design decisions. This is to be supported with empirical data (Dwivedi et al,
2009, pp.187). Further, development of new theoretical constructs from data is needed to improve rational design in emergence. (Dwivedi et al, 2009, pp.187)

8 TODA AND WBIS DEVELOPMENT

Table 2 describes how ToDA categorises the problems experienced in the first Brunel University student services project (action research investigation). The categories are planned action, emergence and deferred action. By categorising the phenomenon within the theory three constructs enabled the web developer to more accurately monitor the phenomenon being experienced.

<table>
<thead>
<tr>
<th>Brunel University Student Services</th>
<th>Planned Action</th>
<th>Emergence</th>
<th>Deferred Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A meeting was organised to finalise the layout of the student service WBIS. This involved a meeting with the manager and web developer. The meeting was setup to sign off the final layout design of the WBIS.</td>
<td>The meeting took place, but the manager didn’t what to finalise the final layout. The manager wanted other stakeholders’ involvement in order to reassure judgement. Further a demonstration of how the WBIS worked needed to be arranged.</td>
<td>A new meeting was setup. This included the other stakeholders. The web developer had to arrange a presentation of the WBIS system. This involved testing the WBIS on cross browsers (Internet Explorer and Mozilla Firefox).</td>
</tr>
</tbody>
</table>

Table 1. Three dimension of ToDA aligned with Brunel University Student Services WBIS development.

Table 3 describes how ToDA categorises the problems experienced in the second action research investigation (Brunel University student research handbook project). These three categories of ToDA are planned action, emergence and deferred action. The categorisation of the phenomenon enabled the web developer to explain the problems encountered within an emergent higher education organisation. This enabled the web developer to investigate the problems encountered more accurately through the construct of deferred action.

<table>
<thead>
<tr>
<th>Brunel University Student Research Handbook</th>
<th>Planned Action</th>
<th>Emergence</th>
<th>Deferred Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Brunel graduate school commissioned a report which set out requirements for the development of an improved student research handbook WBIS. This report was given to the web developer to implement.</td>
<td>The web developer encountered a problem. This problem involved the development of other WBIS parallel to the development of the SRH WBIS. The web developer had to work on the most essential requirements first. Due to the time scale involved, not all changes could be implemented in time</td>
<td>The Brunel graduate school arranged the selection of appropriate requirements that needed to be implemented first. The manager agreed on the layout changes that needed to be implemented as soon as possible.</td>
</tr>
</tbody>
</table>

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Table 3

| Three dimension of ToDA aligned with Brunel University Student Research Handbook WBIS development. |
|---|---|
| for the deadline. The web developer relayed this information via email to the Brunel graduate school. |

Table 2 and Table 3 show the usefulness of ToDA in helping the web developer to understand the phenomenon. Without the theory it would be difficult to understand the emergent aspects that are encountered throughout the WBIS development process.

9 CONCLUSION AND FURTHER SCOPE FOR WBIS THEORY IN AN EMERGENT HIGHER EDUCATION ORGANISATION

In summary, there are different types of theories available for WBIS. It is critical for today’s researcher to decipher an appropriate and applicable theory from the eighty-three available theories in the IS domain.

Gregor (2006) establishes that IS has problems of its own in relation to theory. This is so because it’s an interdisciplinary field, which is concerned with both the study of technology and human behaviour. Many scholars have backgrounds in diverse fields, from mathematics, to management and the natural sciences. Reconciling the different views depends on our goals and the necessary critical steps which are needed to move the process forward.

The researcher uses the ToDA as informing practice to improve the rational development of WBIS for an emergent higher education organisation. Weber (2003) makes a good argument for the need to develop our “own” theory that characterises our field. Though Gregor (2006) appears to label the IS community as: ‘still struggling to identify strong theories that are unique to IS’. Conducting this research brings qualitative refutation to the ToDA with its potential to become a reference theory for the IS discipline and organisational studies. Adversely, for ToDA to become a reference theory, scholars argue that its refutation needs both qualitative and quantitative testing in order to generate an applicable theory (Nagel, 1961).

Further action research is currently being undertaken to investigate how the Kadar Matrix can improve the speed of time-to-market. This will be done through monitoring (data-gathering) its effectiveness within different WBIS development projects. This aligned with ToDA can add more rigour to its actual effectiveness in actuality.

References


