WEB-BASED INFORMATION SYSTEMS DEVELOPMENT AND DYNAMIC ORGANISATIONAL CHANGE: THE NEED FOR EMERGENT DEVELOPMENT TOOLS

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Abstract

This paper considers contextual issues relating to the problem of developing web-based information systems in and for emergent organisations. It postulates that the methods available suffer because of sudden and unexpected changing characteristics within the organisation. The Theory of Deferred Action is used as the basis for the development of an emergent development tool. Many tools for managing change in a continuously changing organisation are susceptible to inadequacy. The insights proposed are believed to assist designers in developing functional and relevant approaches within dynamic organisational contexts.

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

INTRODUCTION

Developing Web-based information systems in today's changing work place is a problem that needs better tools to accommodate dynamic organisational change. By investigating the problem in the work place it will give the opportunity to understand the problem and propose a solution that can be continuously tested in its environment. This is the aim of our research in progress reported in this paper.

The notion of whether current development methods are able to adequately handle today's organisation, emerged from the work of Truex, Baskerville and Klien (1999). Since then Bello (2002) highlights the increase in today's fast pace environment and its development of technologically innovations and the need for emergent development tools. This need is further evident from Kautz, Madsen and Norbjerg (2007) argument on Web-based Information Systems (WBIS) needing new concepts, methodologies and tools. The need for these changes may seem obvious on the surface level, but the problems and conditions facing today's organisations are not, they are different from the challenges previously experienced.

Today's organisations demand increasingly more multimedia features and tailored web-based information systems. This increased demand puts the web developer under extreme pressure for multimedia features (video, audio, graphics) which can make development methodologies inadequate (Lang, 2002). Further Barry and Lang (2001a) reveal that the graphic design role is a significant process within the development cycle. Though more crucially web developers and graphic designers have different perceptions and values. This creates importance of developing a common resolution of cross-cultural paradigms.

Patel and Hackney (2008) give further impetus to the lack of understanding of emergent properties in current system analysis and design. To this effect the incorporation of emergent properties within methodologies is logically flawed, as the very act of modelling assumes it can be predicted. Truex et al (1999) define this unpredictability within an organisational context as "constantly seeking stability, while never achieving it". Truex et al (1999) goes on to construct this notion as being "emergent". Bello (2002) agrees the construct of "emergent" organisation are those that are in continuous evolution and transformation.

Following no predefined pattern it is difficult to research and develop emergent development methods that accommodate actual emergence in a continuously changing environment. A stable structure does not underpin the organisation in this context. In effect the phenomenon needs a research methodology that is designed to capture and modify change iteratively. Action research may be defined as an emergent inquiry process in which applied science knowledge is integrated with existing organizational knowledge and applied to solve real organizational problems (Shani and Pasmore 1985: 439).

PROBLEM STATEMENT

The problem is developing in and for emergent organisations when the web developer is under increased demand to design WBIS in a dynamically changing environment (Bansler et al, 2000; Carstensen et al, 2001; Holck, 2002; Lang, 2002; Murugesan et al, 2001; Vidgen, 2002; Kautz & Norberg, 2003; Kautz, Madsen & Nørbjerg, 2007). Investigating how an emergent organisation develops WBIS with Web-based aesthetics and Internet Speed being problematic for the development process generates a problem focus that needs investigating to aid the development of knowledge for both theory and practice (Howcroft and Carroll 2000; Baskerville et al, 2003; Baskerville et al, 2004; Kautz, Madsen & Nørbjerg, 2007). These critical aspects of WBIS development (Web-based Aesthetics & Internet Speed) is predominantly implemented by the web developer. Centring the research investigation on the web developer is key to understanding the problem in its volatile organisational context.

The need for an appropriate research methodology like action research is needed to learn about the actual and situated practice of WBIS development through first-hand experience as it's critical to the development of applicable knowledge. This criticality is needed in order to draw on theory, gain feedback, modify the theory to practice and try it out again. Using this type of investigative methodology can give new insights into understanding the problem in its context and derive new emergent development tools. Coghlan and McDonagh (2001) suggest this form of action research to confront major dilemmas facing organisational change when specifically related to integrating information technology into organisations and making major contribution to their resolution.

The research looks to help web developers understand and develop solutions for environments where emergent organisational change, Internet Speed and Web-based Aesthetics are prominent, as defined below. To generate such a solution (development tool) the research aims to utilise existing emergence theory to provide the basis and backbone for developing an appropriate web developer tool.

ACTION RESEARCH PROJECT

The relationship with Brunel University Student Services 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 and tools that could be used to improve the current WBIS already in place. The project undertaken reports on an action research investigation that spanned two years and involved the development of many WBIS Student Services. These Web-based student services had to

ultimately provide continuously better support for students each year, which is dynamic and problematic when mixed 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, fast paced 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 placed at the forefront of the development process lends itself to understanding and improving the development process in the context of dynamic organisational change.

INVOKE THE THEORY OF DEFERRED ACTION

The action research project aligns theory to practice and looks to extending that theory in order to develop an emergent development tool for web developers.

The rationale for invoking the Theory of Deferred Action (ToDA) (Patel, 2006) is to invoke a theory that generates 'usable knowledge' which incorporates the emergence design dimension. This generates the basis for developing emergent tools to cope with emergence. This 'theory for action and design' (Gregor, 2006) proposes three design dimensions: planned action, emergence, and deferred action. The correlation determines the types of organisation and system design possible. It postulates systems can be predetermined and specified through planned action, to introducing the emergence aspect of generating less specified systems that emerge throughout the development process. In an environment where organisations are dynamic and specification is not concrete. The notion of 'Deferred Action' is used to facilitate the understanding of this emergent activity. This in turn depicts the notion of Deferred Systems, as a type of system which is "a way of achieving formal objectives that combines knowable rules and procedures with actuality' (Patel, 2006).

ToDA is used as a basis for developing tools to cope with emergence from a web developer in a Web Based Information System development context. As a reflective web developer (Designer) you are "limited by extent of organisational and sociological (content) design they can expect to know, it is necessary to provide mechanism to action designers to do deferred design" (Patel 2006: 12).

Patel and Hackney (2008) propose the four dimensional analysis based on the Theory of Deferred Action to enable systems analysis of emergence and its modelling for systems design. This enables the ability to establish what structural and functional design can be deferred. Patel's (2006) seeks a form of continuous system analysis.

Patel's (2006) gDRASS matrix (Figure 1) models emergent organisations and possible system design types. The synthesised interrelations which are themselves correlated postulate design principles and the development of appropriate design techniques. Hence it can be used to describe, analyse, and explain systems design and design domains.

The gDRASS matrix interrelated constructs are; Formalism, Deferred Action, Emergence (Emergent Organisation) and Diffusion Management as noted in Table 1.

gDRASS Constructs	**Definition**
Formalism	Prescribes precise rules for creating structural forms to achieve set objectives.
Deferred Action	Is concerned with enabling actual action as interrelation design with formal design.

Emergence (Emergent Organisation)	Is an unknowable and unpredictable social action. (Social Action that is organised but subject to emergence)
Diffusion Management	The joint responsibility of reflective and action designers to manage organisation and systems structure and operations.

Table 1. gDRASS Constructs (Patel, 2006)

When these constructs are interrelated they propose four types of design; Deferred Design, Real Design, Autonomous Design and Specified Design as noted in Table 2.

Types of Design	**Definition**
Deferred Design	Design by action designers within formal design to cope with unknowable emergence.
Autonomous Design	When design capability is afforded to intelligent machines by reflective designers that become autonomous of humans.
Real Design	Design of structures and operations by rational design for enactment in emergent actuality and responsive to it in real time.
Specified Design	Conducted by reflective designers from specification obtained from users

Table 2. gDRASS Design Types (Patel, 2006)

The constructs of the gDRASS matrix creates interrelationships among the design dimensions. This type of tool (Figure 1) enables the developer to model design systems in actuality. By invoking ToDA as the basis of developing an emergent Web-based Information System development tool, this research aims to adapt constructs of the gDRASS matrix to be applicable in a WBIS development context.

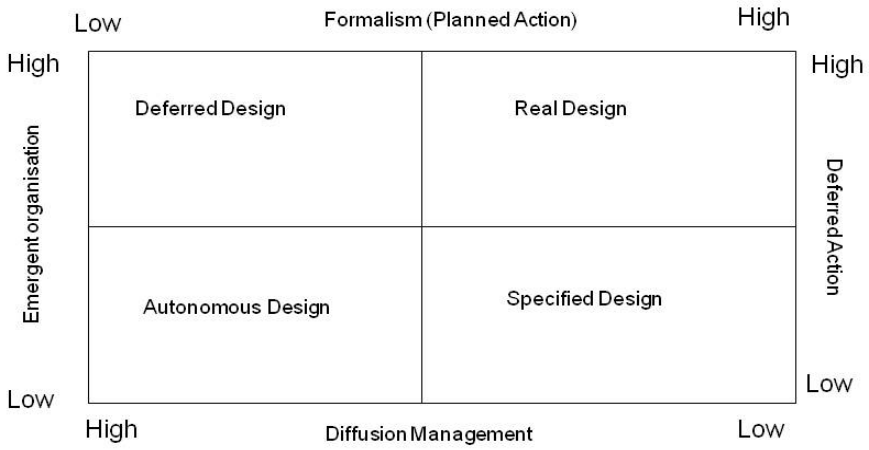

Figure 1: Patel (2006) gDRASS matrix design types

ACTION RESEARCH DATA

The data-gathering tools selected are designed to fit both the organisational setting and the purpose 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: journaling, emails, work documents and unstructured interviews.

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 in relation to the project. The second reflection 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. Zuber-Skerritt and Perry (2002) call this the 'core' and 'thesis' part of the action research cycle.

This tailored rigorous framework incorporates the traditional iterative process of diagnosing, planning action, taking action, evaluating action. With continuously interpreting, taking action, experiencing and reflecting in action. Through adapting the framework to capture this information it aids the identification of the problems and solutions carried out in practice (Coghlan and McAuliffee, 2003).

This form of iterative method captures the problem in its context and gives the researcher a methodological development tool to modify and try out the changes to theory in actuality. Through data generating in this format it identifies how the web developer reacts to the problem of managing the process of WBIS in its environment. Having a deeper contextual tool to understand how a web developer constructs its web-based information system in an emergent environment enables the development of emergent tools.

The data generation begins with the premise that it is important for a web developer working in a broad range of organisations to develop WBIS systems to the demands of the manager and organisation desired specification. This AR cycle highlighted the need for an emergent development tool for the purpose of aiding the web developer. Given this, academics and professionals alike are interested in asking and finding answers to the following question:

How can the web developer improve the web-based development process within the organisation?

Below, a description of each of the iterations of the AR cycle is provided.

(Diagnosing) **Problem in Development**	**(Planning Action)** **Action in Development**	**(Taking Action)** **Solution in Development**
The project consisted of developing a student services web-based information system that encompasses rich information on the different services provided. The manager proposed the problem of how to select appropriate features within the WBIS.	Many of the requirements had to be agreed with the different student services sections. This involved organising and arranging meetings with the different services managers. A time consuming process that involved meeting the different departments and mapping down what was needed.	The student services manager met with the different services to discuss ideas on how they would like it to be designed. The manager mapped out what features the different student services requested. The web developer discussed what methods could accommodate the different features in development. Based on the web developer ability to develop WBIS an agreement was made to pursue

		two different methods of initial development. The manager would of liked to know what features could be incorporated before meeting with the different service managers. The web developer felt you couldn't rule out the use of a feature until it is tested within its environment.
Experiencing, Reflecting, Interpreting, Tacking Action	**Experiencing, Reflecting, Interpreting, Tacking Action**	**Experiencing, Reflecting, Interpreting, Tacking Action**
Having this problem made the action researcher feel excited to have the opportunity to develop a WBIS for a wide audience. Though reflecting on what methodologies can be successfully applied to the project, gave the thought of doubt in developing in actuality. Essentially the AR had to review the process of relevant methodologies. Having looked at the methods for development, an appropriate method was selected.	The thought of the manager having to get a collective agreement with the different services made the web developer feel more focused and content with implementing the development process. Knowing the entire role of what the web developer had to implement from start to finish was the reason for the contented feeling. Having started the communication and progress updates daily gave the resultant clear direction.	Due to the different Web Based Aesthetics requirements and level of Internet Speed the manager isn't able to make a collective agreement with the different services. The web developer role had to incorporate aiding the decision on what can and cannot be developed. Apprehensive about this process the action researcher had to develop a web developer tool to overcome this problem. From reflecting on the problem, I (web developer) needed to utilise an emergent tool that could aid this development process.

(Evaluating Action) - What did I learn?

Agreement:

The web developer experience and knowledge of methodology's affects the manager's ability to incorporate the features required for WBIS development.

To develop an emergent development tool that can be used when encountering the demand for features to incorporate in the development process.

Disagreement:

To test the applicability of the design requirement, it is necessary to test it within its actual environment.

Experiencing, Reflecting, Interpreting, Tacking Action

With the fast paced web-based development process and the dominance of "time to market" (Baskerville and Pries-Heje, 2002), the demand to meet deadlines is equally essential when compared with the need to develop the features. Having this type of pressure held up the web developer ability to prepare and plan out the development process according to a specified method.

Both web developer and manager felt it was necessary to develop a better way of understanding what stage the development process was currently at and what the web developer could contribute. Using a theory that models emergence process would enable the development of such a tool.

Table 3. Action Research Cycle

Implementing this type of Action Research inquiry (Table 3) into the steps of the cycles itself is central to the development of actionable knowledge (Argyris, 2003). The action research data captures the problem of creating a development tool to inform both manager and web developer in actuality. It then looks at invoking a suitable theory to develop an emergent web-based development tool.

WEB DEVELOPER EMERGENT DEVELOPMENT TOOL

The constructs from the Kadar matrix are adapted from the gDRASS matrix. Modelling for specified design with gDRASS matrix demonstrates low emergence, low deferred action, high level of planned action and low level of diffusion management. This correlates to the specified methodology quadrant located in the bottom left corner of the Kadar matrix. Where there is low emergence, low web developer ability, low level of internet speed and a low level of Web-based aesthetics.

Following this interrelationship, deferred design takes place in the top left quadrant of the Kadar Matrix where there is high levels of emergence, Internet Speed with low-medium levels of Web-based aesthetics and Web Developer ability. The modelling of real design, takes place where all four constructs are at a high level (top right quadrant).

The bottom right quadrant displays a design element not categorised as a form of design from the gDRASS matrix, though its inclusion demonstrates a Web-based development type in the context of an emergent organisation. Table 4 demonstrates and explains the interrelationships between the constructs.

The action research data, positions the web developer as being in the deferred design quadrant (top left). As the data shows high level of continuous change, low level of prescribed rules (formalism), high level of the action-researcher participation in organisation and systems structure(diffusion management) and high level of deferred action (where planned action meets actual action).

The taxonomy of the Kadar matrix constructs in Figure 2 is described as follows:

Emergent Organisation

Referring to an organisation as emergent means every feature of social organisations-culture, meaning, social relationships, decision processes and so on-are continually emergent, following no predefined pattern. The organisation may exhibit temporal regularities, but recognisable only in hindsight, because organisations are always in process; they are never fully formed (Truex et al 1999).

Web Based Aesthetics

This construct is a significant design role within the WBIS development cycle (Barry and Lang, 2001b). Dependant on the emergent organisation demand for increasingly more multimedia features will determine the level of involvement. Though more crucially web developers and graphic designers have different perceptions and values. This creates importance of developing a common resolution of cross-cultural paradigms. Today's dynamic organisations demand increasingly more multimedia

features and tailored WBIS. This increased demand puts the web developer under extreme pressure for multimedia features (video, audio, graphics) which can make web development methodologies inadequate (Lang 2002).

Internet Speed

The notion of 'Internet Speed' was developed alongside the birth of the WWW and the dot com explosion in the 1990s. This new paradigm gave new focus to time-to-market, customer focus and the ability to respond to changing business needs (Baskerville & Pries-Heje 2002).

Web Developer

How a web developer conducts the development process in a continuously changing organisation, with static tools, is of great importance. It can demonstrate new meaning and develop theory that might prove beneficial for academics and developers (practitioners) within an emergent organisation context.

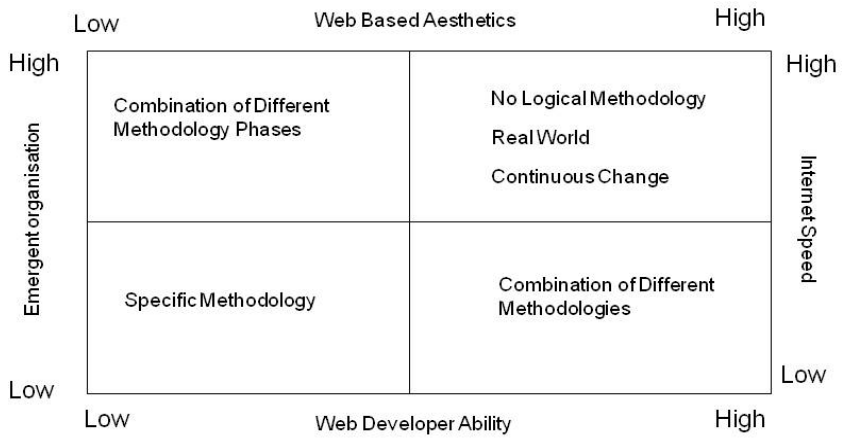

Figure 2: Kadar Matrix - Adaptation of gDRASS matrix (Patel, 2006) for Web Based Information System Development

Kadar Matrix Quadrant Types

The design types in Table 4 are themselves correlated. The taxonomy with the constructs derived from the data is construed from the student services action research project which revealed possible types of coherent WBIS methods. These types are:

Kadar Matrix Quadrants	
Combination of Different Methodology Phases (Top Left Quadrant)	**No Logical Methodology / Real World / Continuous Change** (Top Right Quadrant)
High level of Continuous Change within the organisation Web Developer knowledge and ability to implement a few methodologies Time to market is high, increased demand to deliver the WBIS within a short development cycle. Demand for Web Aesthetics is Low - Medium	High level of Continuous Change within the organisation Web Developer knowledge and ability to implement a few different methodologies Time to market is high, increased demand to deliver the WBIS within a short development cycle. Demand for Web Aesthetics is High
Specific Methodology (Bottom Left Quadrant)	**Combination of Different Methodologies** (Bottom Right Quadrant)
Low level of Continuous Change within the organisation Web Developer knowledge limited to one or two methodologies Time to market is low, resulting less pressure to develop WBIS on time Demand for Web Aesthetics is low	Low level of continuous change within the organisation Web Developer knowledge and ability to implement many different methodologies Time to market is low – medium, less pressure to develop within a short development cycle Demand for Web Aesthetics is medium – high

Table 4 Kadar Matrix Quadrant Types

CONCLUSION

The paper identifies WBIS development problems through literature and action research data, with an adaptation of the gDRASS matrix as a possible WBIS web developer tool (Kadar matrix) to help position the web developer potential contribution throughout the development process. With this knowledge the web developer can advise more accurately with the manager about meeting today's volatile demands for WBIS development.

This research extends ToDA by utilising the constructs of the gDRASS matrix and adapting them for the purpose of developing a Web-based Information System development tool (Kadar matrix) that web developers use in actuality (emergent organisations).

The Action Research data reaffirms the Web-based development position of the web developer when using the Kadar matrix in an emergent organisation. This aids the web developer, manager and organisation by having a collective overall position.

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

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