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Using the PSIC Model to Understand Change in an Educational Setting: The Case of an E-Textbook Implementation

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USING THE PSIC MODEL TO UNDERSTAND CHANGE IN AN EDUCATIONAL SETTING: THE CASE OF AN E-TEXTBOOK IMPLEMENTATION

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Abstract

This paper reports on an analysis of the change caused by an e-textbook implementation in a school in South Africa. The PSIC model, a change model from ICT enabled change in organisations, was considered because it affirms existing educational research, but also extends it by recognising the episodic nature of change. On a vertical level the model allowed the researchers to identify and distinguish between the factors and events influencing change in the organisation on four different levels. On a horizontal level, the model makes the disequilibrium between the socio-technical system components visible as they happen over time. Data was collected during an interpretive case study and analysed using the PSIC model. It is found that, despite the preparatory events leading to the full roll out, as well as the positive affordances of the new technology, the equilibrium of the socio-technical components of the work system was severely disrupted. The technology infrastructure did not support the e-textbook systems and more than one system was implemented which caused confusion. Teachers' experienced that support for teachers and learners was not sufficient and that the e-textbooks did not support the learning and teaching task. Consequently, the researchers suggested some interventions of which some have already been implemented.

Keywords: e-textbooks, PSIC model, socio-technical change, ICT enabled change in education.

1 Introduction

E-textbooks is a technology which maintains many promises but which is slow to be adopted in educational settings. Publishers, policy makers and service providers seem to agree on the bright future of e-textbooks (Nicholas, Rowlands et al., 2008; Reynolds, 2011; Lowinger, 2013). The promised advantages are legio – from lighter backpacks, up to date learning material, and reduced cost, to interactive cooperative learning and informal learning (Lowinger, 2013; Stern, 2013). However, there is general agreement that the introduction of e-textbooks in educational environments entails much more than simply replacing printed books with digital ones (Sun, Flores et al., 2012). It has implications for infrastructure (Sun, Flores et al., 2012); (Robinson, 2011), teaching practices and ways of interacting with textbooks (Daniel and Woody, 2013) to name but a few. Clearly, the implementation of e-textbooks induces change in schools. The success of such an implementation seems to be dependent on its compatibility with the learning and teaching environment (Lim, Zhao et al., 2013).

Several studies address the need for the understanding and management of changes resulting from new technology in schools. Ng et al. (2013) propose a people-centred framework for mobile technology implementation in schools which recognises the technical and people-related aspects of such complex environments. This includes management, teachers, students, technicians and the wider community (parents, suppliers, software developers etc.). The change dynamics is caused and driven by the interpersonal relationships between these role players. Similarly, Lim (2002) acknowledges the social and technical factors involved in ICT integration in schools. He uses Activity Theory to view ICT implementation in educational environments from a sociocultural angle. Risquez and Moore (2013) focus more on selected groups within the changed environment. They argue for determining the change readiness in educational environments by considering the psychoanalytical dynamics of the teacher group. The two psychoanalytical concepts of individuation and congruence are used. Similarly, by focusing on selected aspects of the change environment, Tondeur, Van Keer, Van Braak, and Valcke (2008) established that structural (e.g. infrastructure, planning and support) and cultural (leadership, goal orientedness and innovativeness) characteristics of schools affect educational change. Related to the management of change, Ng et al. (2013) mention the importance of inclusive and communicative leadership. Lim et al. (2013) emphasise the importance of a technology policy plan setting out an agreed vision for the use of technology in the school. According to them this plan also needs to describe expectations, goals, content, professional development and evaluation. The opinions and suggestions of all stakeholders, especially of the learners and teachers, should be reflected in such a policy plan. It is clear that scholars working on change, resulting from ICT implementation in educational environments, recognise the social, technical and multi-faceted nature of such environments. However, since technology implementation in schools is generally done in haphazard and inconsistent ways (Selwyn, 2011), the area of research on ICT enabled change in schools is not well developed yet.

This paper aims to contribute to this body of knowledge by considering a case of e-textbook implementation in a secondary school in South Africa. In 2013, this school embarked on a journey to replace printed textbooks with e-textbooks. Initially a pilot project was run which involved only one school grade. This was followed by a full roll-out early in 2014, which was plagued with several problems and due to the fact that considerable resistance was experienced, the school's principle approached the authors for advice a few months into the implementation. Using action research, the authors decided to gain an understanding of the change in this school, which resulted from the implementation of the e-textbook platform, and then formulate suggestions on how to manage the change. The findings reported on here are limited to the first phase of "diagnosing" the problem and the first suggestions made as only teachers were consulted to gain an understanding of the change environment. The next phase of the research will additionally involve learners and parents to reach a more complete understanding and to evaluate the actions that were taken as a result of the authors' suggestions.

The case study described in this paper, provides an interesting departure from most research cases concerning ICT implementation in schools. This implementation is not seen as an experiment but is institutionalised by a management decision, which is very much in line with ICT implementation in organisations. For this reason, change theories pertaining to ICT in organisations were considered to guide and conduct this research. The Punctuated Socio-Technical Information System Change Model (PSIC) of Lyytinen and Newman (2008) is chosen as a change theory and is used to enable an understanding of the change process which took place due to the implementation.

2 ICT related organisational change

In a seminal article by Markus and Robey (1988) ICT and organisational change is labelled a vital matter in the field of IS. They challenge change models which focus on the rationality of managers to lead the change and on the potential of ICTs to create change in organisational work practices (planned models), by suggesting the development of process-based approaches which could be used to understand emergent changes (Orlikowski, 2000). Such approaches draw attention to the social context within which the change takes place. This social context includes a range of important factors that could assist in explaining why ICT change initiatives in many cases fail (Barrett, Grant et al., 2006). According to Markus and Robey (1988), the emergent perspective to change is better equipped to gain an understanding of the long-term relationship between ICT and organisational change as the impact of ICT on the organisation is said to be dynamic and to continue for quite some time after the implementation thereof. To this extend Constantinides and Barrett (2006) explain that "the development and use of ICTs in organizations is conceptualized as the consequence of a series of decisions and interactions among different interest groups or actors in different roles within the organisation or between organizations and of unintended occurrences including external events."

Benjamin and Levinson (1993) also maintain that change enabled by IT is different in the sense that managers of IT-enabled change need to know how to "integrate the technology, business processes, and organisation in order to achieve the goals they expect with the technology." According to Avgerou (2001) the change studies done in the field of IS, differ in terms of the change 'content' they address; the explanation of the 'environment' they study; as well as the way in which the 'process' of change is understood, relative to the environment within which it takes place. On the relationship between content and context, she reports that most IS studies focus on technological change, attempting to develop effective technologies and ways in which to manage and use it effectively. Such studies would focus on the environment for the sole purpose of it being a source of opportunities or constraints for the technology implementation, ignoring the unfolding of the organisational and social changes interacting with the technology implementation. Other studies focus on technology as the 'content' of change, and the socio-organisational conditions under which it takes place, as the 'context' of change, thus separating the two. A third group of IS researchers, study IS as 'socio-technical' systems and have drawn on several different theoretical and epistemological aspects of the social sciences to highlight the social effects of new technologies, incorporating ideas such as duality of technology; social constructionism; and actor network theory, to study the joint partaking of technology and human actors in forming intertwined socio-technical entities.

One of the latest models of this kind is the punctuated socio-technical IS change (PSIC) model by Lyytinen and Newman (2008), which will be described in the next section.

3 The Punctuated Socio-technical IS Change (PSIC) model

Lyytinen and Newman (2008) criticises IS change models as descriptive or prescriptive models explaining the process of change on only a single level. In doing this, these models neglect to describe

the interactions that take place between multiple systems and the organisation's environment during the change process. In contrast to this, their Punctuated Socio-technical IS Change (PSIC) model is a hybrid model which could be used to explain multifaceted change. It aims to explain the reasons for (why?) and the way in which (how?) IS change takes place and is an attempt to come up with a guide on how to build "generalizable and localized socio-technical explanations of IS change.", (Lyytinen and Newman, 2008) In this regard, IS change is considered to be a complex, socio-technical and episodic phenomenon. The model addresses the following three aspects of IS change: the scope; the nature; and the content. This is done by integrating three theoretical streams: theories of multi-level systems and punctuated equilibrium; socio-technical systems theory (describing the content of the change); and process theorising. The three aspects of IS change will now be discussed in more detail (Lyytinen and Newman, 2008):

- The scope of IS change: The PSIC model views IS change as being multi-levelled. The levels referred to here are seen as socio-technical systems and include:
    - the work system: this system which is changed by inserting new IT components into it. This system is highly ridged complex and shows characteristics of work habits, fixed ways of performing tasks, and cognitive boredom.
    - the building system: this system incorporates the resources and routines to enact the planned and deliberate change. It needs the necessary power to rectify resistance to the change, to acquire the resources and to justify the change.
    - the organisational environment: the work system and the building system are both rooted in the organisational environment. This environment is split into two parts of which the first is the organisational context (or the inner context, including the resources, authority, culture and politics) and the second is the environmental context (or the outer context including the social, economic, political, regulatory and competitive environments).

  Both vertical and horizontal analysis could be done on the multiple levels. With vertical analysis the interdependencies cross cutting the three levels discussed above is analysed, while horizontal analysis examines the interaction between the work system and the building system and the transformation that takes place in these systems over time. In this sense the model could be used to determine what was done in the building system to bring the change about; what was the effect on the work system and what did actually change; and what was the effect of the environment on both the building and the work systems.
- The nature of IS change: The PSIC model is based on theories of episodic change (Gersick, 1991) and views the nature of IS change to have episodes of revolutionary punctuations (or system disorder), followed by periods of stability with only slow moving small alterations.
- The content of change: The PSIC model views the content of change as punctuated socio-technical change. It uses the S-T model of Leavitt (1964) (see Figure 1) to describe the content and the so-called 'engine' of change. This model views organisations as systems possessing four interacting components: task; structure; actor; and technology. Their motivation for using this model to explain the content of change is that it is "simple, extensive, sufficiently well defined, and anchored in the extant theory.", (Lyytinen and Newman, 2008).

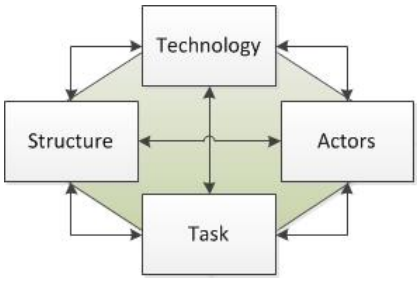

Figure 1: Leavitt's S-T Model (1964)

IS change is therefore viewed as a "subtle interplay between technologies, actors, organizational relationships, and tasks at multiple levels. The change can either be incremental or punctuated and it is co-evolutionary in that it distinguishes multiple separate, but interacting streams of events – the work system, the building system and the organisational environment. Any of these socio-technical systems has the potential to inject gaps that will trigger interventions into the focal systems leading occasionally to punctuations.", (Lyytinen and Newman, 2008).

The PSIC model illustrates how existing socio-technical compositions, shaped by history, exist in the work system until a planned or unplanned incident causes a gap between one or more of the S-T pairs in this system. This gap leads to an unstable state and could consequently lead to interventions aimed at removing it. The result could be that the gap is successfully removed, but it could also fail in which case it would lead to even more gaps (unintended consequences). Some interventions such as introducing a new technology or new information system into the work system, could in contrast lead to punctuations that create a new deep structure in the work system.

4 Research context

A South African ICT education company EduX (an alias) provides an e-textbook platform as part of a suite of e-learning offerings. It involves the replacement of printed text books with e-textbooks on tablets in schools. In addition this platform enables teachers to push content, links or comments to the textbooks and allows learners to highlight, comment on and summarise important content. The e-textbooks are interactive and in ePub format. What makes this technology attractive is that the technology does not replace the teacher, but enables a blended learning environment, which may include traditional learning practices.

An initial pilot project was run, involving only the learners and teachers of a single grade. Tablets were issued to the learners and both the learners and teachers received training on the use of the e-textbook system. Although problems were experienced with the Wi-Fi and physical network, the governing body decided to roll out the implementation of the e-textbook platform to all grades, except the final year grade. Currently, each learner has to buy a tablet (any make) with the required specifications. Most learners and teachers have internet access at home. E-textbooks are purchased from EduX and then downloaded from the EduX server at the school. The e-books are updated with the latest information pushed by the teachers though the Wi-Fi connection at school or at home. The Moodle learning platform is used as learning management system with the e-textbook platform. All notes and highlights made by students are backed up on the EduX servers, which allows for it to be downloaded again should a tablet get stolen or damaged. The school also provides tablets that can be borrowed in the event of damage or theft.

At the time of the full implementation, EduX only provided e-textbooks published by one local publishing company. As these textbooks were not always the teachers' preferred choices, the school decided to additionally allow the use of a pdf reader to the e-textbook platform of EduX, in an attempt to

provide the teachers (and learners) with a greater choice of textbooks. In contrast to the EduX e-textbooks, the pdf reader does not provide any interactivity. EduX provided and is still providing on-site support to the teachers during school hours. The IT personnel of the school also assist in supporting teachers and learners with the use of the system.

The roll out of the e-textbook platforms in the beginning of the school year was plagued with problems, mainly due to Wi-Fi and network issues. Once the e-textbooks were installed on the learners' tablets, the teachers started to voice their complaints about matters relating to the learning environment in the classrooms. (This is discussed in greater detail in section 6 of this paper).

5 Research design

The aim of this study is to gain an understanding of the change that resulted from the implementation of the e-textbook platform, in an attempt to provide suggestions to the school's management on how to manage the change. This paper reports on a part of this study, namely the gaining of an understanding of the change environment from the perspectives of the teachers only. An interpretivist philosophical approach is followed and action research is used as research method. Qualitative data was collected through interviews and through teacher opinions posted on a group decision software system, during a brain storming session held at the school. Detailed notes were taken during interviews.

Using the model of action research provided by Susman and Evered (1978) as explained in Myers (2009), the research process is explained below:

- Diagnosing: The PSIC model was used as a theoretical lens to gain an in depth understanding of the change that took place in the case described in section 4 of this paper. To apply this model, a historical path for the incidents leading to the decision to implement the e-textbooks was important. Such data was therefore gathered through interviews with stakeholders (the principal and a member of the IT committee) who had been involved in the management of the secondary school (before the implementation), as well as those who were contracted from the external environment to implement the e-textbook platform (a representative from EduX). However, the main focus was the opinions and perceptions of the teachers. This decision was mainly due to the principal's urgent need for information and feedback from the teacher group.

  The PSIC model (and specifically the S-T model part of it) was utilised to construct questions to be asked to and discuss with the teachers at the secondary school. Example questions asked to understand the effect the technology had on the teachers' task, are: "In what way did you use the printed text book before the implementation of the e-textbook?"; "How did the implementation of the e-textbook change or influence the way in which you are performing your task as teacher?") These questions were formulated and placed within a brainstorming session which was constructed using the thinktank group decision support software, licensed to the University of Pretoria. The thinktank software enabled the participants to anonymously participate in the group session by allowing them to type their individual answers to the questions posed. The aim was to determine the extent to which the implementation of the e-textbooks had forced the elements in the S-T model out of equilibrium, causing gaps which could consequently be causing the problems and obstacles prohibiting a successful change to the proposed e-textbook platform. Thirty-one teachers participated in this session.

- Action planning: The data gathered from these sessions were analysed using the PSIC model. Eventually it was transformed into suggestions on how to get the S-T components back into equilibrium (see section 6 for more details). These suggestions were communicated to the school principle in a written report format. The authors also identified the top priority findings that needed immediate action (see the last paragraph of section 6).

- Action Taking: The authors provided the school principle with the name of an independent network consultant who visited the school for a detailed evaluation of the existing Wi-Fi network's setup and capabilities. Since this evaluation, the Wi-Fi infrastructure was upgraded and the internet access of the learners is now properly managed.
- Evaluation: This phase of the action research cycle has not yet been completed. The authors plan to revisit the teachers and other stakeholders in order to report on the current state of the project implementation and the effects the suggestions given to the principle might have had on the project.
- Specifying learning: The insights gained from the research done are discussed in detail in section 6 of this paper.

6 Findings

In this section the researchers will elaborate on the findings and insights gained from applying the PSIC model to understand the e-textbook implementation. The unfolding of the events/issues as they took place or resulted over time and as they led to other events/issues in the external environment, organisational environment, work system and building system, as well as the effect(s) thereof on the equilibrium between the components of the S-T model in the work and building system, is illustrated in **Error! Reference source not found.** (on the next page) and will consequently be discussed in more detail. This is done by referring to the individually identified events in the building and work systems as they occurred over time.

Building system and Work system events:

B1: The decision to install a Wi-Fi before the Pilot project to support the implementation of e-textbooks. This had no effect on the equilibrium of S-T model components in the building system.

B2: The pilot project was rolled out to a single grade with selected subjects, utilising only the e-textbook platform provided by EduX. This again had no effect on the equilibrium of the S-T model components, as the Wi-Fi was (with only a few tablet users) sufficient to support the e-textbook system. Teachers were trained in using the e-textbook platform. Some of them indicated their preference for textbooks not provided on this platform. In general though, change was well accepted. This was confirmed by questionnaires sent out by the school

W1: The implementation of the pilot project into the work system caused the first episodic change (punctuation) to the work system. Although this was an episodic change it did not disrupt the work system, as work (for most of the learners – those in other grades) carried on as usual with no disruption. There was no visible disequilibrium between any of the S-T model components.

B3: The decision was taken to continue with a full roll-out and implementation of the e-textbook system. In the building system there was a gap emerging between the technology (e-textbook system) and the task (facilitating the course using the best available content) since some of the available textbooks on the platform provided by EduX were not sufficient or on standard according to the teaching staff.

B4: The school's existing alliance with their previous book seller (which was part of the external environment), together with their loyalty towards this bookseller (a relationship built over the years) led to the decision taken to implement a second e-textbook platform to conform to the teachers' needs for better electronic content. This caused another gap between the technology and the task in the building system. Difficulties were experienced with integrating the client payment and distribution aspects of the two e-textbook platforms (EduX and PDF reader system). It was further determined that this gap was not completely resolved before full implementation into the work system.

B5: The decision to roll out a full implementation of both e-textbook systems (EduX and PDF reader) to all grades except the final school grade. This was done while there still existed a disequilibrium between the technology and task components as described in B4.

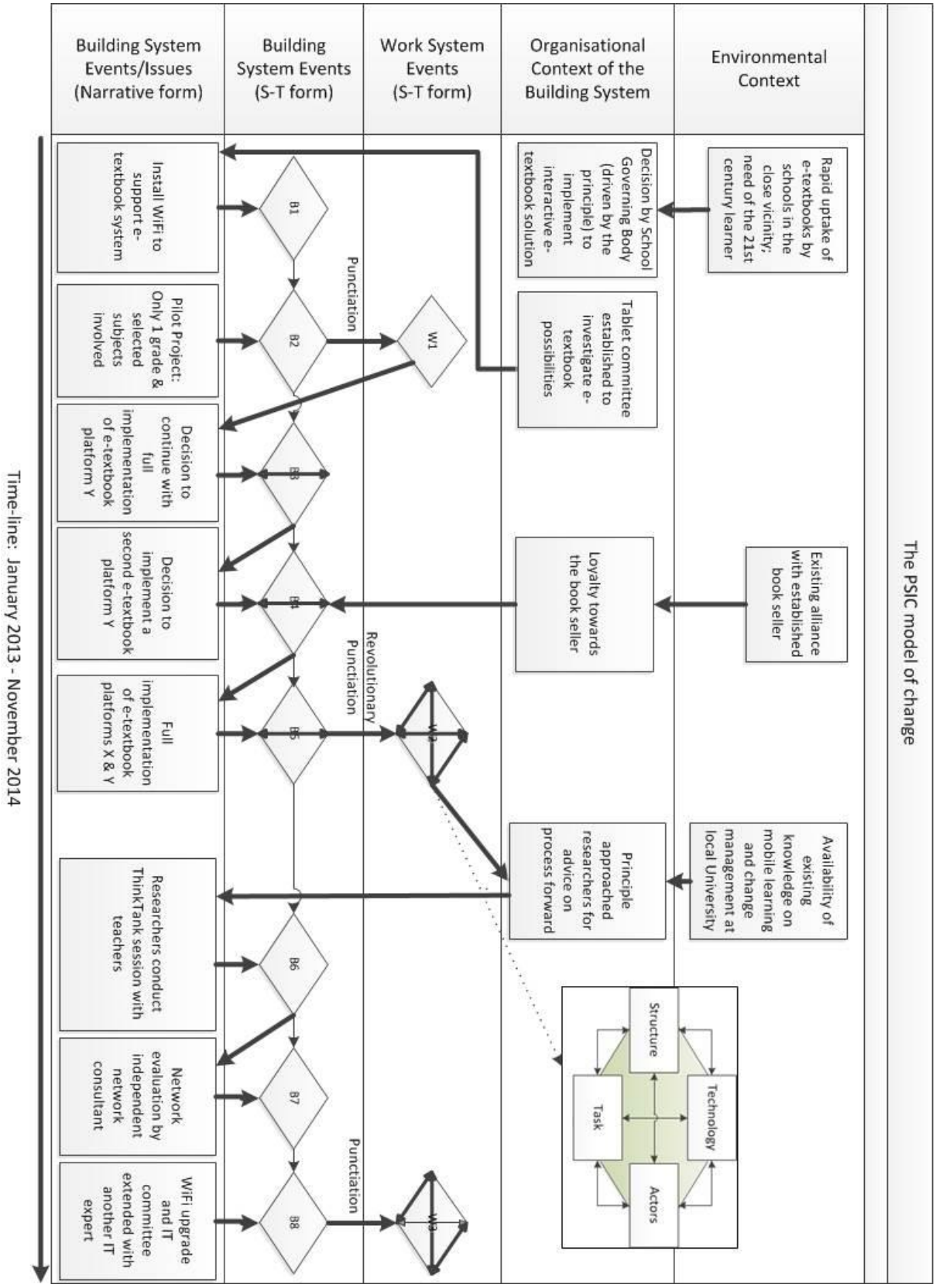

Figure 2: The PSIC model applied to the e-textbook implementation project

W2: The full roll-out and the implementation of the two e-textbook platforms into the work system. This event caused revolutionary change (punctuation) in the work system, causing several of the S-T model components to move into disequilibrium. Each of these S-T relationships will be discussed in detail in

Table 1 below, in conjunction with supporting evidence gained from the thinktank session held with the teachers (all remarks are translated from Afrikaans to English):

S-T model components in disequilibrium	**Gap**	**Supporting evidence**
1. Task-Technology	i. Technology too slow to support teaching and learning task	"In many cases the Internet is very slow - to such an extent that we struggle to complete a task." "Our internet is too slow, everything is always hanging. If it was not for that, it would have been very easy to use the book." "I first have to wait for the e-textbook to load and it also takes time for learners to open it." "It is extremely frustrating with the system which is slow or not online." "We cannot manage to open the book on the tablet." "It takes time for learners to open the e-textbooks. This wastes our teaching time." "In many cases the network is off. This reduces the teaching time and consequently places more stress on the teachers."
	ii. Tablets	"The tablets break too easily." "Sometimes a learner's tablet is in for repairs. I then have to print the relevant pages for this learner. This takes up too much time." "The tablets break, batteries are not charged and the different tablets function in different ways, making it difficult to assist learners with problems." "There is no eye-contact with the learners anymore – they constantly look at their tables." "Learners forget their tablets at home."
	iii. E-textbooks	"There are learners that find it difficult to page through the book. Some of them get lost in the e-textbook." "It is difficult to work on more than one page at the same time." "Learners enjoy the tablets because their backpacks are lighter and they can play their games but they prefer hard copy textbooks to study from."

S-T model components in disequilibrium	Gap	Supporting evidence
		"Many parents bought printed textbooks as well." "The e-textbooks provided are not on standard." "There are better textbooks available than those provided to us as e-textbooks." "It does not work well for using and working with maps in Geography." "We would like to see two pages next to each other at the same time."
2. Structure-Actor	i. Absence of champion ii. Lack of support iii. More training needed	"We were sent to and fro between different people. In spite of this, no one was really able to assist us or to solve our problems. We had to figure it out all by ourselves." "There is need for more support to learners to sort out the problems with their tablets and e-textbooks." "It sometimes feels like there is no one to ask for help as they are all busy sorting out their own problems."
	iv. Perception of teachers that their opinions on the implementation are not important	"We are forced to use the e-textbooks which look nice but which are not on standard." "It was definitely not the teachers that took the decision to change to e-textbooks." "I told them that I did not feel comfortable to use the e-textbooks but nobody listened." "It was not the teachers who took this decision. The decision was made too hastily."
3. Technology-Actor	i. Lack of knowledge in the following areas: • how to operate a tablet • how to effectively use the e-textbook in the classroom	"I need more training such that I can feel more in control." "I want to learn more because I need to answer the many questions of learners." "I feel disabled. I do not even have basic computer literacy skills and I don't believe it is my responsibility to pay for an expensive computer literacy course." "The learners laugh at us behind our backs as we struggle to implement and use this." "I asked no one for help as I feel stupid not knowing how to use the new technology."
	ii. Two different platforms iii. No standard of technology implementa-	"I like system A (the interactive e-textbooks) but system B (the pdf reader) worries me." "System B is difficult to use." (Note: System A's e-textbooks do not have

S-T model components in disequilibrium	Gap	Supporting evidence
	tion	page numbers but system B's e-textbooks have page numbers. This makes consistent referencing to specific content difficult.)
	iv. Little control over learners in the class-room	"Learners download games on their tablets which makes the e-textbooks slower." "We do not have the time to check who are playing games in class and who is actually working." "Learners are not always paying attention in class and many of them are playing games while we are teaching."
4. Structure-Task	i. Full roll out too soon	"Given the problems we experience the decision to move to e-textbooks was not well thought through." "It was done too early, sorry!" "It should have been implemented more gradually (over time). I think the technology still needs to improve before everything will run smoothly."

Table 1: A description of S-T model components in disequilibrium

B6: The frustrations experienced by the roll-out of the project in the work system, together with the availability of existing knowledge on mobile learning and change management at a local University, led the school principle to approach the researchers, requesting an investigation into the problems and a report suggesting the way forward. This investigation did not create any new disequilibrium between the S-T model components, but pointed out the gaps in W2 as explained in

Table 1 above. It is important to note that the researchers did experience some uncooperativeness and hostility from some IT staff members, who obviously were afraid of getting exposed to any wrongdoings with regards to the way in which the networks were setup and utilised.

B7: The investigation done by us led to some suggestions offered in an attempt to manage the S-T model components which were found to be out of equilibrium and explained in

Table 1 above. The first suggestion made was to get an external independent network consultant to evaluate the network setup and Wi-Fi infrastructure. This did not cause any of the S-T model components to move into disequilibrium, but caused some resistance from the school's IT personnel who were threatened by the idea of having someone else inspecting their work.

B8: Another IT expert was added to the school's IT committee and the Wi-Fi was upgraded in reaction to the report of the external independent consultant.

W3: Although most of the Wi-Fi problems were solved when the upgrade was done in the work system, it only relieved the disequilibrium between the Task – Technology components to a certain extent, as nothing has yet been done in connection with the tablets and e-textbook problems experienced in this relationship (as discussed in

Table 1 above).

Apart from the suggestion to appoint an external independent network consultant, the researchers also made the following suggestions in the written report to the principal: (Note that these were not yet addressed and are expected to be reported on in future research done on this project.)

- Identify a successful and enthusiastic teacher who could act as a 'champion' for the e-textbook systems;
- Move to only a single e-textbook platform to simplify the working of e-textbooks the for all lecturers and learners;
- Implement subject specific training on the use of e-textbooks in the classroom;
- Organise informal information sessions around the e-textbook implementation;
- Investigate the possibility to limit what learners use their tablets for by means of rules or software;
- Organise small group discussions (which include representatives of all stakeholders) per subject per grade in preparation for 2015.

7 Discussion

In applying the PSIC model to the case described in section 4, it was apparent that this model assisted in providing a detailed socio-technical understanding of the change which resulted from the e-textbook implementation. On a vertical level the model allowed the researchers to identify and distinguish between the factors, events and decisions on the environmental, organisational, operational (the work system) and systems development (building system) levels – refer back to **Error! Reference source not found.**. In this regard, the trends set by neighbouring schools in the uptake of new technology were identified as an environmental factor influencing the decision to implement the e-textbook solution. In addition, existing alliances of the school with service providers were also identified as influences from the external environment. It is shown how initial events (the installation of the Wi-Fi and the pilot project) did not affect the system's stability, but that the decision to use two platforms and the full roll out thereof triggered the revolutionary punctuation or system disorder. The system disorder is conceptualised as disequilibrium/gaps between some of the components of the S-T model in both the building and work systems – (refer back to Table 1). On a horizontal level, the PSIC model makes these gaps visible as they happen over time. This assisted the authors to identify the problems which were caused by the disequilibrium and allowed them to communicate these in a written report to the school principle. In addition this report also included possible future events in the building system which could assist in solving the issues experienced in the work system because of the disequilibrium.

The use of the PSIC model to describe and understand ICT enabled change in educational environments, contributes to existing literature in the following way. Similar to existing research it recognises the multifaceted complex nature of such change environments, but it also explicates the scope of ICT enabled change (from organisational level to work and building systems). Also, similar to existing research it recognises the socio-technical nature of change, but provides a theory (the S-T theory of Leavitt – see Figure 1) to describe and analyse the socio-technical system as the content of change. Finally, addressing a gap in existing research on ICT enabled change in schools, the PSIC model understands the nature of change as episodic and describes change as a sequence of events leading to sometimes small alterations and occasionally, revolutionary punctuations. This last mentioned affordance is of value in this particular case since the e-textbook platform will be institutionalised and become part of the day to day operations of the school in the future due to a strategic decision made by the management of the school. For this to realise, a thorough understanding is necessary of the gaps between the S-T components in both the building and the work systems, as well as the necessary future interventions or events which might be needed to eventually stabilise the working system.

8 Conclusion

This paper reports on an analysis of the change caused by an e-textbook implementation in a school in South Africa. The case study reported on is an interesting departure from most cases described in educational literature, as it is not an experiment or short lived project, but a long term technology implementation, driven by management. For this reason, change models from ICT enabled change in organisations were considered. The PSIC model was chosen because it affirms existing educational research on ICT enabled change and also extends existing research by recognising the episodic nature of change. The model was used to guide a brainstorming session with one group of role players, namely the teachers. It was also used to analyse the comments made by teachers, as well as the history of the implementation events. It was found that, despite the preparatory events leading to the full roll out, the equilibrium of the socio-technical components of the work system was severely disrupted during the implementation. The technology infrastructure did not support the e-textbook systems and more than one system was implemented which caused confusion. The perception was that support for teachers and learners was not sufficient and that the e-textbooks did not support the learning and teaching task. Although several teachers highlighted the positive affordances of the technology (searching for new information; making the content interactive; enabling lighter backpacks; etc.), the lack of proper infrastructure made it difficult to use the technology to its full potential. Consequently, the researchers suggested some interventions of which one has already realised: an independent evaluation of the Wi-Fi and network was done recently, with the effect of rectifying the disequilibrium between the task and technology components of the S-T model to a certain extent.

A limitation of the research is that the findings are mostly based on one group of role players' (the teachers) experiences. The researchers plan to conduct similar sessions with the learners and other role players to expand their current understanding. This could assist in refining the current suggestions and/or in identifying new interventions aimed at managing the implementation process. In addition, it was found that existing and newly formed alliances between different role players played an important role in the change environment (refer back to event B4 described in section 7 for an example). As acknowledged by Lyytinen and Newman (2008) the S-T model (within the PSIC model) seems to be limited in its ability to accommodate for such political intrigues. The simplicity of the model makes it attractive, but the researchers plan to for future research also consider other theories such as that of Du Plooy (2003) to enhance this part of the PSIC model.

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