

Academic Group and Forum on Facebook: Social, Serious Studies or Synergy?

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Abstract: An academic group and discussion forum were established on Facebook for a cohort of postgraduate students studying the concepts and principles of eLearning. The Forum had a constructivist, student-centric ethos, in which students initiated topics for discussion, while the course leader and administrator facilitated. Previous research has been conducted, involving content analysis of the topics and academic discourse, but the present study focuses on social aspects, investigating social- and study-related pursuits and determining whether synergy can exist between them. A literature review shows how social networking by students, initially social, began to overlap with academia, leading to the use of groups for academic purposes and forums for subject-related discussions. In the present study, data was triangulated and two methods of data analysis were used. *Qualitative analysis* was done on *free-text data from students' reflective essays* to extract socially-related themes. *Heuristic evaluation* was conducted by expert evaluators, who investigated *forum discourse* in line with contemporary learning theory and who considered the social culture of participation. Findings of the qualitative analysis of students' perceptions and results of the heuristic evaluation of forum participation confirmed each other, indicating a warm social climate and a conducive, well-facilitated environment that supported individual participation styles. It fostered inter-personal relationships between distance learners, as well as study-related relationships due to peer teaching and insights acquired from social negotiation. The environment supported student-initiative, but was moderated by facilitators. The mixed-methods research approach of evaluating students' essays and conducting expert analysis of forum discussions showed the advent of a virtual community with a synergy between social aspects and academia. Most participants experienced a sound balance of social- and study-related benefits, but with a stronger focus on academic matters.

Keywords: eLearning, evaluation, Facebook group, online discussion forums, qualitative analysis

1. Introduction

Social networking sites (SNS's) are increasingly used in academia. This paper discusses the social climate of an academic group and online discussion forum (ODF) established on the SNS, Facebook, to enhance learning for postgraduate distance-learners studying 'Concepts and Principles of eLearning' at the University of South Africa (UNISA). Most of the students were professionals.

ODF's are a common feature in web-based groups and eLearning environments. UNISA, a distance-education institution, provides ODF's on its official site, but we offered an alternative supplementary group and discussion forum on Facebook for a postgraduate cohort. It had a constructivist, student-centric nature, in which students personally initiated the discussion topics. The course leader and an administrator facilitated as *guides on the side*, rather than as *sages on the stage*. The aim was to encourage interaction that provided subject-related information and academic discourse. Early research about the Group (de Villiers, 2010) involved content analysis of the topics and discussions, using quantitative frequency counts of interaction types, and qualitative discourse analysis to investigate the academic content. The study showed that active participation in the Forum supported learning and enhanced performance. Secondary benefits also occurred, including the emergence of peer-to-peer relationships. The present study therefore focuses on social aspects of the Group.

2. Literature review

Various studies have addressed students' use of SNS's and determined that interactions were primarily social (Madge, Meek, Wellens and Hooley, 2009; Selwyn, 2009). In an online survey of 600 student users, Mazman and Usluel (2010) found they visited Facebook for approximately 30 minutes daily, mainly for socializing. A meta-analysis of 36 studies on students' and teachers' use of Facebook, indicates little educational use (Hew, 2011). According to Lampe, Ellison and Steinfield (2008), Facebook is ubiquitous on US campuses with the typical user visiting for 80 minutes daily. However, Lampe *et al* found that academic matters such as lectures, reading materials, deliverables, and instructors were mentioned and about 15% of students used Facebook to contact lecturers. Selwyn (2009) studied Facebook Walls of UK undergraduates, visiting over 600 sites with public viewing profiles. Four percent of the exchanges related to academic schedules, venues, lectures and deliverables, while another theme was criticism of keen students, seminars and lecturers.

Nevertheless, educational use is on the increase and explicit academic use of SNS's is reported. Four case studies on social networking by students (Jones, Blackey, Fitzgibbon and Chew, 2010) show a divide between students' learning space and personal space, yet acknowledge that educators should leverage SNS's and create environments for independent learning, reflection, and communities of inquiry. Mazman and Usluel (2010) define educational use of Facebook as involving *communication* (discussions and information); *collaboration* in groups; and *resource sharing* via videos and links.

There is increasing academic use of Facebook in South Africa, the home base of the authors. Bosch (2009:147) did a 'virtual ethnographic' study of Facebook profiles of 200 students, supplemented by interviews with students and staff who communicated on Facebook and found that the experience undid 'traditional power hierarchies'. Students were more engaged on Facebook than on the official course management site. Many belonged to groups for societies and academic programmes, where they shared resources and logistical information and checked class-related material. Visagie and de Villiers (2010) (not the present author) surveyed 32 academics and established that 56% of them would consider using Facebook as an academic tool. As academic use of Facebook increases, research is being conducted on subject-related discourse in groups and communities. The primary author of this paper did detailed analysis of the academic content of the discourse on a postgraduate discussion forum (de Villiers, 2010). First-year students participated in peer-initiated topic-based conversations in a systematic and well-articulated way (Rambe and Ng'ambi, 2011). Informal learning occurred in a social-constructivist community where students and instructors conversed and shared knowledge to help each other understand the subject matter better (Ractham and Firpo, 2011).

3. Research design and methods

The research question addressed in this study is:

Did the venture serve both social- and study-related pursuits in a synergistic manner?

To evaluate whether academic forums on Facebook can have a synergistic value, we focused on the social culture and interaction patterns described by students in reflective essays and identified by heuristic evaluators studying the discussions. We investigated whether the Forum supported personal participation styles and valuable interaction. The tone, nature, impact and facilitation of the discussions were considered, as well as the ethos of the community. This study evaluates the integration of social aspects and serious studies, by using a mixed-methods research approach (Creswell, 2009), which was triangulated by two evaluation methods and two different datasets:

Study 1 *Qualitative analysis of free-text data from students' reflective essays*: These perceptions were qualitatively analysed using a form of *grounded theory*.

Study 2 *Heuristic evaluation (HE)* by four expert evaluators: These experts investigated *forum contributions* to determine the social climate and to establish whether the ethos of the discussions conformed to contemporary eLearning theories. These evaluations were mainly *quantitative*.

The research incorporated data triangulation as both essays and forum discourse were analysed, and methodological triangulation via the combination of qualitative analysis and heuristic evaluation. For ethical reasons participants were informed that research was being conducted, and they signed informed consent forms.

4. Study 1: Qualitative analysis of free-text data from students' reflective essays

Membership of the Group was encouraged, but not compulsory. Thirty of the 40 in the cohort joined. Twenty seven completed the course, including 21 Group members, twelve of whom were very active on the Forum. Textual data from the students' reflective essays was analysed by grounded theory and categorised under themes and sub-themes that emerged. The findings are presented and supported by groups of quotations from students' essays, in the students' words. The students whose reflections are quoted, are cited, e.g. P1 represents Participant 1 and NP1 is Non-Participant 1.

4.1 Social vibes and ethos of the virtual community

In off-forum essays, students gave varying perspectives on the ethos and impact of the discourse.

Virtuality became Reality

Distance dissipated, as participants got 'to know each other' and conversed 'in the presence of peers':

'Since it is often outside the classroom that students get to real knowledge sharing, social networks can play a major role in informal social learning, giving access to each others' implicit knowledge'.

'The group are friendly, enthusiastic and passionate about the subject... the interaction is excellent'.

The group became a community and had a sense of real-world talking and listening:

'If I share my thoughts, I like to know who is listening. It is gratifying to interact with people with a common goal'.

'What you teach fellow students is embedded in your mind longer... because you say it to people'

(P3, P5, P12, P14, P17).

Culture and tone of interactions

The environment was warm and conducive to discussions. Some students built relationships and conversed off-forum. Although real-world academia can be self-focused and competitive, the Group culture was not geared to personal achievement:

'The best is that users freely share their sources of information, how they interpret concepts, and their personal experiences'.

'Wisdom of crowds... the whole is greater than the parts'.

'Make or break depends on support of peers... those with experience and intent to help can mentor and guide novices in social networking'.

'I enjoyed interacting with fellow students on a social level, although I did not benefit academically'.

'Interaction was enjoyable and fulfilling'.

'I have (previously) used forums to pose questions and seek answers, but I disliked the dull, standardized and uncreative way they were presented'.

The tone was informal yet cordial: 'Nobody addressed the lecturer as "Madame", yet on the other hand, there was no use of shortcuts like B4, 2b or LOL' (P4, P6, P7, P13, P16, P27).

Removal of isolation

'Standard, boring distance Learning was enriched'; 'The sense of isolation dissipated'.

To a long-term distance-learner, it was 'a thrilling experience. The first exotic e-fun occurred when fellow-students introduced themselves as if sitting alongside me, but writing from Australia, Japan, Namibia, Pretoria' (P1, P4, P12).

Challenge, yet affirmation

Written words do not vaporise like spoken words and this calls for careful reflection before posting:

'... a new-found sense of pressure to understand what I was reading'.

'Someone else was going to be reading it, and giving their opinion' (P13, P21).

However, contributing brought affirmation: 'The brief experience when I shared my views was a turning point...My confidence peaked...'

'It was heartening to see that a number of fellow-students agreed... '.

'Being introvert, I only made one comment, but it is a start'.

'Participating with the professor and fellow students, I felt honoured to be part of the exercise and especially getting accolades for my contributions' (P2, P25, P27).

4.2 Support for individual styles of participation

Most students found the Group and Forum supportive. Several exercised pro-active leadership and initiated topics, while others saw it as a place to participate in discussions without the exposure of contact-learning. Yet others chose not to contribute, but observed and 'listened'. They benefitted, although some fellow-learners did not appreciate having observers. While some students found the atmosphere of the Forum to be non-intimidating, other tended to be daunted:

Better than a real classroom

Some participants were more comfortable conversing on Facebook than in a conventional classroom:

'Sharing is less rigid than when responding to questions in a class'.

Learners are 'not frowned on when they express themselves in whatever way they feel comfortable'.

'People are less afraid, and speak without fear of being mocked' (P7, P17).

'It eliminated possible first-line prejudices that might have occurred in a contact situation. One considered the content and not the person' (P21).

'Got more feedback than in class situations, where a few students may dominate' (P4).

Non-intimidating – a place to take initiative

The ethos encouraged some members to be forthcoming:

'Should I take the initiative?...it was clear this was a place to take charge... Grasping the new-found freedom, I decided to start...'

'Some are outspoken and involved in everything, with quick responses, but others keep to themselves'.

We could '...have a brainstorm session' (P7, P13, P17).

Daunting

Some felt intimidated and inadequate. They feared negative responses or no response:

Exposure to '...some refined and polished contributions, led to feelings of academic inferiority'.

'People can be afraid to express views, because they are unsure of relevance and accuracy'.

'You would like to contribute or ask questions, but wonder if you will look stupid' (P5, P10, P21).

Responses to postings

Contributors anticipated responses to their postings and were disappointed if this did not happen fast:

'You are demoralised if no feedback is forthcoming'.

'The time-independent nature of the interactions meant that discussions were sometimes drawn out, preventing immediate feedback...'

'You (have to) wait for the response when somebody is online' (P8, P16, P21).

Observers

Some perceived the Group as a safe space for learning without contributing. They chose to learn by watching and listening, yet without the negative connotations of 'lurking'. Certain participants were disturbed by these onlookers:

'I experienced frustration when just a few participants contributed, though I realise that some preferred to read what others wrote rather than contributing'.

'Some joined the group, but did not make any postings'.

'Some students joined but kept silent... just watching, a bit creepy!' (P1, P17, P27).

P25, who was an observer, explained, 'I go on forum to see if someone asks what I want to know. It helps me know if I am going in the correct direction. I log in daily and am disappointed when there are no new contributions'.

4.3 Academia on Web 2.0 and Facebook

On Web 1.0 and via eLearning 1.0, learners access existing educational Web content. In contrast, Web 2.0 and eLearning 2.0 (Ebner, 2007) empower learners to personally contribute content.

Web 2.0 and a paradigm shift

In the context of education 'Web 2.0 means a learner-centric approach' (P16).

More a 'social revolution'/ 'social phenomenon' than a technological issue.

'...a paradigm shift... we need to relinquish tried and tested ways, which takes time and not everyone joined the revolution' (P7, P8, P16).

Some could be 'even more sociable than before' but 'others are just not sociable' (P12).

Several cited Ebner (2007), 'Technical issues will be solved quickly, but to change the thinking about learning and teaching is hard and long'.

'We can't expect everyone to feel comfortable with social tools, but change is a constant...' (P3, P11).

Academia on Facebook

Some were convinced that this was the way forward:

'For someone like me, who already uses Facebook and enjoys working smartly, Fb provides a single point of entry from which I interact socially, stay up to date, and participate in communities... I am comfortable using it as a learning tool'.

'This type of discussion forum works with what is already available'.

'We are the mobile-interconnected-global-village generation with Web 2.0 Fever' (P7, P13).

Furthermore, Facebook is ideal for forums. 'It is well-structured with predefined areas for discussions, the Wall for banter, pictures and videos, membership lists, ways to handle permission and access';

'...has global interconnection' and 'You can reach members personally by accessing profile pages'. '...a co-operative environment that fosters trust among learners and instructor', allowing students to 'learn from one another' (P7, P11, P13, P18).

P11 made a strong statement: 'Educational institutions should use Facebook for learning and make links from their institutional websites'.

Shy users and silent users

Facebook breaks barriers for those who are shy or who feel vulnerable. Despite being a public space, it provides concealment that shields members when they pass opinions:

Those who 'struggle to socialise' or 'have difficulty with social skills' found it easier to communicate on Facebook than face-to-face. 'Collaborative online learning brings major changes, so that learners with low self-esteem can communicate and comment without physical interaction' (P4, P8, P10).

Then there were the silent observers – see Section 4.2. Some were insecure and chose not to communicate, but essays indicated that others had indeed joined, but were unable to access the Forum. At least two of them wrote on the Wall, but did not find out how to take part in discussions until it was too late (P4, P5). The usability of Facebook and access to Groups has since been improved.

Asynchronicity and synchronicity

Asynchronous interaction via social networking offers Ebner's (2007) 'Triple A Factor: anytime, anywhere, anyone', regardless of location and time (P3). Opinions varied on asynchronicity:

Some appreciated that 'questions and answers could be carefully thought out before posting', whereas others felt that it 'detracted from spontaneity... debate is interrupted by time lapses' or conversely that 'it moved fast, I struggled to contribute'. Furthermore, asynchronicity results in different threads and '... at times, it was difficult to follow them all' (P1, P17, P21).

There was little use of synchronous Chats, although some learners held small-group conversations in real time.

Non-compulsory membership

Several participants would have liked membership to be mandatory, but the course leader took a considered decision not to enforce it. A high achiever who chose not to join, explained why she appreciated the flexibility: 'I have a solitary, intrapersonal and introspective learning style. I ponder and evaluate, and write down thoughts... I tackle problems and solutions alone' (NP1).

4.4 Control and management by the facilitators

Management of the forum was challenging. Since the explicit ethos was student-initiation of discussions, we positioned ourselves as facilitators between the extremes of strong control and hands-off. We served as *guides on the side*, not as *sages on the stage*. Management involved carefully watching accuracy of the content, as well as monitoring security.

Security

Some students felt threatened by security breaches: 'It is difficult for me to use Facebook socially, let alone as a learning tool. My reservations are due to lack of security...' (P11).

We erroneously admitted an *intruder*, believing he was a student whose registration was not finalised. He participated, then posted advertisements for motivational courses and financial products! A disconcerted student unveiled him when they communicated off-forum and she challenged him with an academic question he could not answer: 'It is exciting to say I have encountered an *e-stalker*! Yet I must question how he managed to infiltrate our group' (P1). As facilitators, we immediately removed him. The shrewd P1 picked up another anomaly: 'A profile image introduced a beautiful young lady and we chatted away on academic matters. Her achievements amazed me. After a few weeks she admitted to being "he", an older student, who had borrowed his daughter's Facebook membership (with Prof's permission) due to logistical difficulties'.

Control, please!

Some students wanted tighter management:

*'Such platforms need proper control and facilitation'; 'All content should be verified'.
'People should not be allowed to say just anything – there was irrelevant content on the Wall' (the intruder).*

'Without verification or personal discernment, learners could be misled by inaccurate statements'.

'A weekly question from the facilitators might have encouraged more interaction'.

Another queried whether a discussion forum could be effective without 'central guidance from a lecturer or teacher' (P3, P4, P12, P17).

Constructivism

Others appreciated the constructivist-style freedom and low-level control:

The Forum was an implementation of the current 'focus on cognitivism and constructivism'.

'Well moderated; well managed'.

'A new paradigm of teacher-learner interaction. The course leader merely facilitates and guides'.

It was 'not dictated by the teacher' who is adapting 'to new ways of teaching and guiding'.

It could have been managed 'by fixed principles, but that would curtail the conversation – which was not the idea behind this free, natural learning interaction'.

'The input snippets received from the leader and administrator are gold nuggets'.

(P1, P2, P7, P8, P16, P18).

Reliability and validity

Members and a non-member expressed concern about how to distinguish between fact and the opinions of peers: There was 'potential both to confuse and illuminate, confusing when it's a collection of "I think..." without proper backing. However, when the posts are well thought through and backed with credible references, the potential for real learning is high' (P21).

'Teachers should set standards and test contributions before they are posted on the site' (P3).

Our response to this is, first, that pre-approval is infeasible in forums and, second, as facilitators, we were loath to destroy spontaneity. Monitoring must be done after postings, and be handled with discerning public comments and private communication with offenders. If content was merely weak, we did not react, but on one occasion when discourse veered off-track, the course leader responded by pointing to theory. This concern may have been a reason why some non-participants did not join the Group: 'What proves that the points shared by a student are true and valid?' (NP2).

4.5 Balancing academic and social interactions

To users accustomed to using SNS's for entertainment, the playing fields now offered study facilities!

Successful integration of social and serious

The Wall and Introduce Yourself provided informality. They offset the distance and set a friendly context for the study-related pursuits. Most members felt that social networking and serious studies could be effectively combined. Several mentioned the incorporation of 'fun', 'entertainment', 'informality', 'interactivity' into learning (P4, P7, P8, P14, P16, P17, P21).

'I definitely recommend eLearning via Facebook'.

'I learned to melt into social networking scenes, let the resistance go, flow with the wave, yet keep wearing the academic hat'.

'Push and pull factors: friends pull; academia pushed us to view Facebook as a serious tool'.

'Social and educational tasks are executed simultaneously. I peep at the study group site each time I log on' (P1, P7, P10).

Given their ubiquity, it would be 'short-sighted to ignore Web 2.0 applications' for educational purposes' (P21, citing Ebner, 2007).

Even a non-participant commented, 'Facebook has caused addiction... a study group there could be a good way to study' (NP6).

Distractions

Some struggled with distractions:

'Other Facebook interactions and the whole Internet could easily pull one away...'

'...numerous inviting sites could attract learners to something totally different'.

'Family and friends found me and nagged to be my friend'; '...friends determined to "poke" me'.

'It calls for a change in mindset among those who see it as a fun tool and miss its essence in learning' (P1, P16, P17).

Potential distraction was a reason why one non-participant did not join. 'Literature indicates that SNS tools and systems incorporate high interactivity to keep users interested. This could distract from learning' (NP2).

4.6 Nature of discourse and debate

Simulated face-to-face discussions were enriching for distance learners:

Interactive communication between peers

'The ability to interact with people of similar interests from anywhere in the world, was a definite advantage. One could tap into the collective consciousness of a diverse group of people'.

'We are exposed to having views challenged and can engage in discussions of the subject matter'.

'Opinions differ over same material, but without challenging others disrespectfully'.

'Different perspectives on the same topic...' (P2, P7, P10, P21).

New insights

Students learned from their peers and it is significant that the more active participants all performed well in the examination. Matters emerged that learners had not identified independently:

'Collectively the learners are exposed to an abundance of information... collaboratively they digest content and information within a short time'.

'...useful perspectives, beyond what one would obtain by merely reading the articles'.

'The whole community benefits from one another's insights'.

'Current information and state-of-the art development make a significant contribution to learning'.

And a perceptive point made by different students:

'By posting ideas, we solidify our thoughts. By reading others' responses, our ideas are refined'.

'I gained insight through reading posts of others, and the process of thinking through my responses helped clarify issues'. 'When reading fellow students' input..., my own interpretation changed'

(P2, P10, P16, P21, P25).

Generational differences

Perceptions and approaches deferred. Some older students joined Facebook as novices and became avid contributors. Three participants mentioned their need to print the discourse, while some students from the Net-generation preferred the e-word to the printed or spoken word:

'The ability to recall and regain online discussions is vastly superior to non-eLearning scenarios of searching through paper-based materials or trying to recall verbal conversations' (P21).

'I view Facebook as a purely social tool for the younger generation and unsuitable for academic purposes. It was a novel approach, but should have just been an experiment...' (P27).

5. Study 2: Heuristic evaluation by expert evaluators

Four expert evaluators, who are profiled in Table 1, conducted a heuristic evaluation (HE) to investigate the social climate of the Forum and to assess contributions against contemporary eLearning theories that are based on human-centred values. In order to do the evaluation, they considered sets of criteria (also termed heuristics) to establish whether the discussions conformed to

the pedagogies associated with *constructivism*, *customization* and *creativity*, as well as judging the *social aspects* of the experience.

Table 1: Profiles of the expert evaluators

Evaluator	Occupation	Expertise	Involvement in Group
A	Researcher	Evaluation; ELearning; heuristic evaluation (HE)	No involvement
B	Lecturer and post-graduate student	ELearning environments; HE	Member and active contributor
C	Usability practitioner	Usability evaluation; ELearning websites; HE	Administrator
D	IT professor	ELearning; HE; Human-computer interaction.	No involvement

Each expert evaluator performed his/her evaluation independently. All four were ‘double experts’, namely experts both in eLearning and in heuristic evaluation. One was a student who had been a member of the Group and another was the Group administrator. The evaluators did not see the off-forum reflective essays (Study 1 data), but considered and evaluated the discourse on the Forum.

The evaluation template comprised four sets of criteria, twelve criteria in total, phrased as evaluation statements and rated on a 5 to 1 Likert scale, where 5 was *Strongly agree* and 1 was *Agree*. There were also spaces for evaluators to provide open-ended comments.

Table 2 tabulates the criteria against the quantitative results and is followed by a discussion on the four factors evaluated.

Table 2: Results of the heuristic evaluation

Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)	
Category and criteria – rated on the scale above					Average rating
1. Constructivism					
The activities undertaken in the Group are highly constructivist.					3.5
Participants in discussions think independently and make personal interpretations.					4.125
Discussions moved beyond the curriculum and applied concepts in the real world.					4.75
Cross-criterion average					4.125
2. Customisation					
Participants can customise the time and place of their interactive learning.					5.0
The discussion forum is learner-centric in that participants could select and initiate their own topics for discussion and could contribute personal content.					5.0
Cross-criterion average					5.0
3. Creativity					
Academic discussions in the Forum represent an innovative way of using Facebook for learning purposes.					5.0
Participants responded to the Group environment in creative ways.					4.25
Cross-criterion average					4.625
4. Social climate of the Group					
Interaction on the Forum took place in a friendly and conducive environment.					4.5
The distance learners who joined the Group got to ‘know’ each other.					4.5
The ethos of the Forum supported individual styles of participation.					4.0
Cross-criterion average					4.33
The way the Forum was managed, resulted in a space that was:					
rigid/strictly controlled (1)	firmly controlled (2)	balanced and well moderated (3)	led by students, with leaders on the side (4)	led by students, with leaders hands-off (5)	3.5
Rate the activities and discussions on a spectrum from: (1) Solely Social.....to.....Serious Studies (5)					3.5

Constructivism involves personal goals, knowledge construction and interpretation, and multiple perspectives on issues. Constructivist learning is characterised by active learning, independent

research, collaboration, application to authentic tasks, and real-world situated learning. Customisation entails learner-centricity and adaptability, allowing learners to take initiative regarding (some of) the content, foci and circumstances of learning. Creativity is characterized by innovation within functionality and by engagement and motivation of learners.

There was close consensus between the four evaluators' ratings. Differences between ratings assigned to particular criteria never exceeded 1. Table 2 shows the average rating assigned to each criterion, as well as the cross-criterion average for each factor. In investigating the implementation of *constructivism*, evaluators acknowledged the social-constructivist nature of interactions on the Forum. The nature of the Forum provided scope for participants' personal insights and independent interpretations, and encouraged the application of theoretical concepts to real-world phenomena beyond the curriculum. The cross-criterion average rating for constructivism was 4.125. *Customisation* of learning was unanimously rated at 5.0, since participants could choose the time and place of their activities, while learner-centricity allowed them to initiate topics and match their needs by contributing (or not) in their preferred style. With regard to *creativity*, the expert evaluators' cross-criterion average was 4.625. They felt that Facebook provided a novel and engaging environment for learning in a social context. It was supportive in that the learning occurred in an environment that was attractive, friendly and familiar to most of the Group. The atmosphere fostered innovative strategies, such as posting links to academic articles and communicating one-on-one off-Forum.

Ratings on the Forum's *social climate* averaged 4.33. Evaluators regretted that participation was not higher, but in their open-ended responses, summarized this academic venture on Facebook as a 'very positive experience' and a 'novel way of using social media', where 'students got to know each other academically'. The expert evaluators recognised the community as a 'platform of trust' with 'positive energetic vibes', and 'enough moderation to ensure correct feedback without dampening the student voice'. In evaluating management and facilitation, two evaluators selected '3', and two assigned '4', thus averaging 3.5 and indicating a well-moderated Forum, yet primarily student-led. Similarly, on the spectrum between 'solely social' and 'serious studies', two chose '3' and two chose '4', again averaging 3.5, right of centre and indicating sound balance but stronger on the academic aspects.

6. Conclusions

This section summarizes the findings by concisely re-visiting the research question and by highlighting findings that contribute to new knowledge about ODF's on social networks.

Data collection and analysis involved data triangulation and methodological triangulation. The findings of two studies, namely, qualitative analysis of free-text data from students' reflective essays and heuristic evaluation by experts of contributions to the discussion forum, confirmed each other, and thus provided a positive answer to the research question:

Did the venture serve both social- and study-related pursuits in a synergistic manner?

Synergy results when the combination of factors produces a joint impact greater than the sum of their separate effects. This Facebook venture was indeed synergistic, as students benefitted both socially and academically in social-constructivist interaction. The social setting strengthened the academic interactions while, conversely, academic discourse in the eLearning domain provided a bond that related them socially as peers with similar interests.

Free-text essays articulating the students' own perceptions were analysed qualitatively, and forum interactions were evaluated heuristically according to contemporary learning paradigms with human values. Both sets of results indicated a harmonious social climate that fostered meaningful academic discussions, as participants posted, responded, received feedback and gained insights that enhanced their studies. Conversely, the study-related pursuits of research, interpretation, and discussions on theoretical concepts, led to social negotiation and interpersonal connections. The supportive ethos encouraged most members to be forthcoming, while others, feeling inadequate, experienced the Group as a safe human environment for learning without contributing.

Moreover, the findings provide new information regarding the climate and culture that can be obtained in an ODF on Facebook. Some important points are summarized:

- The nature of discourse in the supportive Facebook environment emulated face-to-face postgraduate contact, providing a perception that the distance-learners actually knew each other.
- Participants' real-world personalities became evident as they exercised their individual communication and learning styles within the virtual community.
- There was an ethos of voluntary sharing, rather than a culture of academic competitiveness.
- The environment was facilitated in a way that encouraged student-centricity, yet the forum was effectively moderated when necessary.

This study showed a synergistic balance of social- and study-related aspects, conducive to studies and to social engagement, but with a stronger focus on academia. Although not all the students in the cohort joined or contributed actively, formerly isolated distance-learners in the Group became a community of practice in the domain of eLearning. These findings should encourage academics to establish groups and discussion forums on social networks.

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Evaluating the Process of Delivering Compelling Value Propositions: The Case of Mobile Payments

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Abstract: The provision of mobile phoned based payments (m-payments) services to the general public requires the cooperation of a number of specific stakeholders, each contributing part of the overall solution, but also each with their different motives, resources and capabilities to deliver compelling value propositions to consumers. The need to combine these multiple perspectives makes exploring the requirements for the design and implementation of m-payment initiatives a complex activity. As a result, sustainable economic business models have yet to emerge for m-payment scenarios. The business model concept has been amply demonstrated to be a very useful tool to understand how to design commercially viable offerings over the last 15 years. The purpose of this research is to theorise the linkages between the numerous elements of an m-payment business model and to evaluate the process whereby stakeholders in an m-payments ecosystem create, exchange and deliver an m-payment solution. By leveraging the business model concept and the process modelling techniques associated with it, the research represents the various stakeholders, in an economic value context, by identifying the role played by each stakeholder and the share of the profit which they expect in return for their contribution. The study is unique in that it tracks the activities and decisions of stakeholders involved in a real-world m-payment initiative from concept stage through to launch stage. As a result, the study provides new insights into the complex and sensitive issues that need to be considered by practitioners, while also providing researchers with a balanced and holistic perspective to a complex phenomenon. It also leverages the business model concept to present detailed models of the m-payment solution implemented in the case study. The preliminary data which we abstracted from the case has validated the relevance of the research questions and will be a valuable contribution to the future creation of an m-payment consortium.

Keywords: mobile payments, M-payments, business model, business process, value networks, value webs

1. Introduction

Due to the fundamental attributes of mobile business (i.e. anytime, anywhere, on any device), organisations are increasingly leveraging such enabling technologies to create value to support mobile users (i.e. employees, consumers) or mobile activities (i.e. tracking materials or products), to improve their operations and subsequently to increase their competitive advantage and financial profit (Coursaris *et al.*, 2006). For example, financial institutions are investing in new payment systems in order to reduce their operating costs, generate new revenue via new fees, and develop their customer relationship, early mover advantage (Dahlberg *et al.*, 2008; FINsights, 2008).

However, if organisations intend to exploit the attributes unique to mobile business, they will need to do so within the context of “effective business models that clearly articulate a compelling value proposition for their employees and customers while addressing their various concerns” (Coursaris *et al.*, 2006, p.7). To create value, organisations will need to learn from past business failures and develop sustainable business models using conventional key performance indicators (KPI's) and not rely on advertising and branding alone (Cassidy, 2003).

It is unclear why mobile services have not lived up to the hype or expectations as promised by its proponents (Damsgaard and Hedman, 2009), there are suggestions that the main issues are poor revenue sharing amongst stakeholders (Ballon and Van Bossuyt, 2006) or static business models being used in the complex environment which is required to deliver mobile services (Coursaris *et al.*, 2006). The uncertainty around establishing a sustainable economic business model that can be agreed by the multiple stakeholders has been identified as a contributing factor for the delayed launch of m-payment initiatives (Chaix and Torre, 2010). What has been established and is generally accepted by researchers and practitioners is that because the context of every m-payment service will be different, then every m-payment solution needs to be specifically customised to satisfy key actors in the m-payment ecosystem (Ondrus and Lyytinen, 2011; FINsights, 2008). These actors include: consumers, merchants, mobile network operators, mobile device manufacturers, financial institutions, software and technology providers, and governments (Dahlberg *et al.*, 2007).

Since no single actor can deliver an end-to-end m-payment service, the success of m-commerce relies on partnerships, thus making 'partnership management' a core competence that will enable stakeholders in the ecosystem to form viable alliances and actor networks (Camponovo and Pigneur, 2002; Pigneur, 2002). Strong partnerships and alliances not only lead to high levels of trust and cooperation but they also enable organisations to achieve market leadership which in turn increases their market reach to co-opt consumers or suppliers within their value-network (Lewis *et al.*, 2003; Currie and Parikh, 2006). However, partnerships and alliances are just one strategic approach to enhance market leadership, too many partners without strategic market positioning could result in weak or unrealistic partnerships leading to business failure (Currie and Parikh, 2006).

While building alliances is one of the most important strategic approaches to creating value in e-business, it is not the only approach for content and network providers to enter the market or increase their competitive advantage (Camponovo and Pigneur, 2003). In order to increase their competitive advantage, organisations will exploit their market position, negotiating power and access to critical resources (Bouwman and Ham, 2003). In addition, access to key functions of billing and information sharing is emerging as a critical success factor in the competition and development of sustainable business models (*ibid*). For example, in the context of payment services, financial institutions have a long tradition of cooperating with merchants whereas cooperating with telecoms and technology vendors is a new experience for them (Dahlberg *et al.*, 2008). Therefore, examining the actor's roles is not sufficient, the relationships and interactions between the actors will also need to be assessed (Camponovo and Pigneur, 2002; Pigneur, 2002).

Even though considerable research has already been conducted to better understand different aspects of the m-payment phenomenon, undertaking this study would answer the call for research that will lead to an 'integrated view' on m-payment business models (Pousttchi *et al.*, 2009) as the success or failure of previous m-payment initiatives were based on issues arising out of multiple perspectives rather than a single perspective (Ondrus *et al.*, 2005).

2. Value-webs

The value chain framework was initially intended to analyse traditional manufacturing industries only, but in recent times it has been used to analyse the mobile industry. However, the framework needs to consider other value configurations (i.e. value net) which better represent the mobile industry. Rather than only focusing on infrastructure and activities, a more comprehensive analysis on elements such as customer relationship, value proposition and partnerships can be achieved by applying the business model concept (Camponovo and Pigneur, 2003).

In a complex value network or value-web (i.e. m-payment ecosystem) where the organisations are engaged in inter-organisational investments, they are connected through intended relationships and interdependencies which involve considerable risks, problem solving and having access to complimentary knowledge (Dahlberg *et al.*, 2008; Bouwman and Ham, 2003). This complexity and combination inevitably requires such organisations to undertake a collective-decision process (Bouwman and Ham, 2003). Unlike the traditional static and linear value-chain, value-webs are flexible and each stakeholder will possess different capabilities and resources which will lead to innovative solutions, when combined together (Moschella, 2003; Faber *et al.*, 2004). As organisations shift from single firm revenue generation to multi-firm control and revenue sharing issues, not only are control and value issues of most relevance to business modelling, but two key questions also emerge "Who controls the value network and the system design?" and "Is substantial value being produced by this model or not?" (Ballon, 2007, p. 2).

Nevertheless, these collective-decision processes have a number of implications when compared to internal process since no single partner has formal authority over another partner; they require prolonged decision-making processes as adjustments need to be discussed and jointly agreed, they demand several rounds of negotiations, there are high costs involved and the possibility of disputes due to conflicting interests which do not always result in a win-win outcome for all stakeholders (Demkes, 1999; Klein-Woolthuis *et al.*, 2005; Faber *et al.*, 2004). There are three types of participants in any new value network (see Table 1): at the core of the network are the structural partners while the contributing and support partners are loosely linked to the network (Bouwman and Ham, 2003).

Table 1: Partnership tier (adapted from Bouwman and Ham, 2003)

Level	Role
Tier 1 (Structural)	Partners provide essential and non-substitutable tangible and/or intangible assets to the enterprise on an equity or non-equity basis. They play a direct and core role in making the customer value assumption and in creating the business model.
Tier 2 (Contributing)	Partners provide goods and/or services to meet requirements that are specific to the enterprise, but otherwise they play no direct role in making the customer value assumption and in creating the business model. If the assets they provide are substituted, the value assumption and the business model could still stand.
Tier 3 (Support)	Partners provide generic goods and services to the enterprise, without which the enterprise would not be viable, but which otherwise could be used in connection with a wide variety of value assumptions and business models.

Table 1 is significant as it indicates that not only do all partners have a role in a value-creating network, whether its playing an important role and having influence in shaping the network or having a minor role and being shaped by the network, such a network inevitably requires ‘partnership management’ (Galbreath, 2002; Kothandaraman and Wilson, 2001). Adopting the partnership tier may be beneficial in order to overcome the symptoms of negative dynamics between some actors which has resulted in “misjudged resource strengths, complementary assets, and market size evaluations” in previous m-payment initiatives (Dahlberg *et al.*, 2008, p. 9).

Cooperation in a value-web is challenging as there is evidence that the organisations experience significant difficulties in attaining mutual benefits from co-operation because each partner may be pursuing strategic goals that are different to the co-operation which in turn may lead to hiding of the truth or acquiring sensitive information from the partners, because the partners are from different industries (i.e. retailers, network providers) there is potential that the diversity could disrupt the ecosystem, and revenue sharing issues (Faber *et al.*, 2004; Ballon, 2007). These challenges can be partly attributed to explain why the success of m-payment platforms remain hampered by recurring and fundamental social, institutional and business challenges that requires a multi-level and multi-perspective holistic approach as it provides a richer picture of the phenomenon (Gao and Damsgaard, 2007; Ondrus and Lyytinen, 2011; Currie and Parikh, 2006; Dahlberg *et al.*, 2008). This means that researching m-payment adoption issues without assessing the institutional and business context will not provide sufficient explanations into a complex, networked technology such as m-payments (Zmijewska and Lawrence, 2005; Ondrus and Lyytinen, 2011).

3. Leveraging the business model concept

Academics have increasingly given attention to developing the business model concept by defining business models, examining their components, classifying them into categories and more recently focusing on representations or developing descriptive models. Yet, there is a paucity of research that theorises the linkages between the variables of the numerous business model domains (e.g. service, finance, organisation, technology), and more specifically, business models used by networked organisations (Faber *et al.*, 2004; Bouwman and Ham, 2003).

When assessing the role of different stakeholders in the m-commerce ecosystem it is suggested to briefly and clearly describe their business models (Camponovo and Pigneur, 2002). Business models also offer a high level of abstraction which is the correct starting point when creating or redefining business processes rather than analysing the business processes themselves (Weigand *et al.*, 2006). Business models and process models provide different support for decisions and requirements of different stakeholders. By commencing a project with a business model design, it states “*what* is offered *by* whom *to* whom, rather than *how* these value-creating activities are selected, negotiated, contracted and fulfilled *operationally*” as is explained by a process model (Gordijn *et al.*, 2000, p. 1).

A business model represents the interplay between multiple industries (Chesbrough and Appleyard, 2007) and is beneficial in determining the underlying logic that explains how an organisation creates and delivers value to their customers while also capturing returns from that value (Magretta, 2002; Shafer *et al.*, 2005). A business model can be an influential tool for analysing, implementing and communicating strategic choices (Magretta, 2002; Shafer *et al.*, 2005). As the functions of a business model are to articulate the value proposition, identify a market segment, define the structure of the value chain and to estimate the cost structure and profit potential (Chesbrough and Rosenbloom, 2002), they are an important locus of innovation and are a critical source of value creation and

competitive advantage for an organisation, its suppliers, partners, and customers (Amit and Zott, 2001; Mitchell and Coles, 2003).

Although the business model concept has been criticised for its “murky definitions and... loose conception of how a company does business and generates revenue” (Porter, 2001, p. 13), the business model concept can be strengthened by aligning it with established theories (e.g. innovation management, strategic management, resource-based theory) that also deal with control and value creation issue in a network (Ballon, 2007). Nevertheless, business models have an important role in business practice (Bodker *et al.*, 2009) because a good business model is essential for any organisation as it answers fundamental questions such as “Who is the customer?” and “What does the customer value” (Magretta, 2002), and it is a vital source of value creation for an organisations suppliers, partners and customers, as well as for innovation (Amit and Zott, 2001).

In the context of explaining mobile business there is extensive knowledge available on descriptive business models and value systems, but there is a lack of models (i.e. causal models) which explain the viability and feasibility of business models, as are case-related analysis and cross-sectional data (Bouwman and Ham, 2003). Aligning the business model with the market environment as well as the industry environment is crucial (Ondrus *et al.*, 2009). Yet, a majority of managers find the business model concept difficult as they either don't understand their current model enough when to know it needs changing or how to make that change (Chesbrough and Schwartz, 2007; Johnson *et al.*, 2008).. Business models in a multi-sided network are about getting stakeholders on board, balancing their respective interests and locking consumers in single or multiple platforms (i.e. multi-homing). (Ballon *et al.*, 2008). When managers consciously operate from a model of how the entire business systems will work, every decision, initiative, and measurement provides valuable feedback (Magretta, 2002).

Business model innovation is the discovery of a fundamentally different business model in an existing business, business model innovators redefine an existing product or service and how it is delivered to the customer (Markides, 2006). Although the ultimate aim of designing a business model is to create sufficient economic and customer value, the challenge is that it requires connecting and balancing design choices in different business model domains while taking into account technical, market and legal developments (Faber *et al.*, 2004). In many instances, the customer value envisaged in the initial design of a business model has little to do with the value as perceived by the customer (e.g. the end-user) as it depends on the customers personal and consumption context (Chen and Dubinsky, 2003; Wieringa and Gordijn, 2005). By understanding the critical design issues in business models and their interdependencies, rather than identifying relatively easy prescriptions, new insights are inserted into the design of ‘balanced’ business models as knowledge of how to effectively balance requirements and strategic interests is limited in the business model literature (Faber *et al.*, 2004).

Adopting the Osterwalder *et al* (2005) business model concept and aligning the research questions to each pillar, (see Table 2), the authors believe that a multi-level and multi-perspective understanding into the design and delivery of an m-payment initiative. As such, the business model concept can be used as a vehicle *for* innovation and also as a subject *of* innovation (Zott *et al.*, 2011). From a practical perspective, the Osterwalder *et al* (2005) business model provides very strong support to this research project as it proposes a complete set of elements, relationships and vocabulary to describe and analyse a business model (Pousttchi *et al.*, 2009).

Table 2: Research questions within the business model concept

Research Question	Pillar	Building Block of Business
RQ 1: How does the adoption of an NFC system change the value propositions offered by service providers?	Product	Value Proposition
RQ 2: How does the adoption of an NFC system change the customer interface?	Customer Interface	Target Customer
		Distribution Channel
		Relationship
RQ 3: How does the adoption of NFC systems change the infrastructure management of the m-payments network?	Infrastructure Management	Value Configuration
		Core Competency
		Partner Network
RQ 4: How can m-payment service providers agree to share the costs and revenues associated with the delivery of an m-payment?	Financial Aspects	Cost Structure
		Revenue Model

The research questions are designed enable the researchers to examine the effect of NFC enabled payment systems on business model development. We are applying these questions to a case study of the development and execution of an m-payment trial on a university campus. The method employed by the researchers to investigate the research questions are presented in the next section.

4. Case study

The data required to achieve the research objective and the associated research questions will be acquired from a real-world m-payment project which will take place on the campus of University College Cork (UCC) and with 250 students as participants. The pilot m-payment project is being facilitated by the Financial Services Innovation Centre (FSIC) in UCC and in collaboration with a leading mobile phone network provider and other stakeholders (i.e. integration partners) from the retail and payments industries. The integration partners in the project include: MNO, handset and operating system manufacturer, the SIM card manufacturer and SIM card integration team, the mobile wallet application developers, the funding account and card issuer, the payment transaction processor, the NFC terminal provider, and IT technicians from the host university.

The data will be generated in the form of focus group interviews with the participants and face-to-face interviews with the retailers and the other stakeholders. The project will go-live in mid-2012 and interviews will be carried out at the pre-launch, mid-launch, and late-launch phases of the project. To-date preliminary data has been gathered and the findings have been useful in guiding the overall direction of the pilot project and to validate the relevance of the research objective and research questions.

5. Research method

Adopting an exploratory research approach is appropriate for this study as it is particularly useful in highly innovative industries, as well as to develop a better understanding of the business problem (i.e. how to deliver compelling value propositions to consumers) by discovering new relationships or patterns (Hair *et al.*, 2007). Further, the use of case studies permits the researcher to examine the phenomenon in its natural setting by employing multiple methods of data collection to gather information from the different stakeholders with the goal of acquiring a rich set of data (Benbasat *et al.*, 1987; Denzin and Lincoln, 2000).

Case studies are also suitable for researching an area in which there is paucity of research and to finding answers to “how” and “why” questions (Franz and Robey, 1984; Benbasat *et al.*, 1987). The benefit of employing a variety of data collection techniques is that collectively they offset limitations specific to each individual technique while also addressing possible anomalies (Gallivan, 1997; McGrath, 1984) and providing the opportunity to triangulate findings, thus reinforcing the conclusions of the study (Kelliher, 2005; Benbasat *et al.*, 1987).

The study will use focus groups and face-to-face interviews to provide a rich set of data, as well as capturing the contextual complexity of m-payments (Yin, 1984; Benbasat *et al.*, 1987; Remenyi and Williams, 1995). Focus group interviews are suitable when the goal of using qualitative research is to generate theoretical ideas and hypotheses which they intend to verify with future quantitative research (Calder, 1977) and have been employed in previous mobile service studies (Jarvenpaa and Lang, 2005; Garfield, 2005). Participants will be selected from naturally formed groups (i.e. college class) as such groups tend to be more relaxed and at ease in conversations (Bryman, 2001). Focus group interviews will also enable the researcher to gather large amounts of data quickly and provide the researcher with multiple perspectives (Wilkinson, 2004). Focus groups are more “naturalistic”, when compared with face-to-face interviews as they generally include a variety of communicative processes such as storytelling, disagreement, humour and cajoling amongst the participants (*ibid*). Due to the sensitive commercial aspects of this pilot project, face-to-face interviews will also be employed in order to reveal issues specific to the various commercial stakeholders (i.e. retailers, mobile network operator (MNO), and financial acquirer) involved in the project.

6. Preliminary findings

The university campus would appear to be an ideal environment to launch an m-payment service due to the ‘village’ effect; technology savvy consumers (i.e. BIS students and staff), merchants in the retail and restaurant business with over thirty point-of-sales (POS), a wireless campus environment, and a host actor (FSIC) all within close proximity to each other.

Nevertheless, a number of unanticipated challenges emerged which subsequently delayed the launch date for the project twice. While technological issues have been identified as fundamental reason for the delay, other issues that threatened the roll-out of the NFC system included managing the partners in the value network, and the issue of project costs and transaction costs remained “the elephant in the room”. For example, interviews with the merchants revealed that they anticipate the potential of m-payments in terms of it reducing the time and cost required to managing physical cash, as well as, a faster through-put at peak service times (e.g. 12pm - 2pm). However, merchants also expressed a high level of commitment to the project on condition that they did not incur the cost of installing the NFC enabled terminals at the thirty three point-of-sales located on campus. Yet, even at the prelaunch phase, cost issues remained “unelaborated”. These issues are specific to research question three and four respectively: “How does the adoption of NFC systems change the infrastructure management of the m-payments network?” and “How can m-payment service providers agree to share the costs and revenues associated with the delivery of an m-payment?” Specific to research question three, the researchers have identified that infrastructure management is a central issue that requires diplomacy, coordination and the need for a shared terminology amongst the integration partners.

Key to the adoption by merchants of this new payment channel are the associated interchange costs. Negotiations between the payment processor and the merchants have been characterised by an extremely stilted discussion which highlights the lack of experience in micro-payments among the acquirers of the transactions. Average values per transaction at a campus POS are between €2 and €3. Certain known value confectionery items are sold at minimal cost compared to high street prices, with margins of 5-8%. When the payment processors consider applying standard acquisition fees to this level of purchase (for example, 14 cent per transaction), it can be seen that merchant margin is wiped out. Furthermore, the merchant must open a merchant ID account with the acquirer, for a one off fee of €250, and additionally spend €7 per terminal per year for support.

From the acquirer's point of view, merchant support and transaction fees are based on traditional debit and credit card interchange rates available from the card networks. However, from the merchant viewpoint, the motivation to promote a new payment channel needs will not come from eating into the tight margins on sub €15 spend items. On the contrary, both acquirers and card networks will need to reconsider the value proposition to merchants (and consumers) if critical mass is to be reached on m-payment adoption. These findings present an early indication that the cultural barriers to new business model development are significant, with players inevitably burdened by their inherited perceptions of customer value propositions.

Such issues demonstrate the need to identify how the stakeholders perceive themselves and the other stakeholders within the value network and in the context of a partnership tier framework. The absence of such a framework may partly explain why there was no explicit “lead actor” in the project or why the stakeholders, who are established players in their own industries, engaged in a project without having a clear business model from the out-set to ensure a win-win outcome for all stakeholders.

From the consumers perspective, the authors have gathered additional data by carrying out a number of focus group interviews at the pre-launch stage where participants (i.e. consumers) were invited to discuss the value-propositions been offered by the use of the NFC enabled phone and the service providers (e.g. research question 1). Key themes that were discussed included: their understanding of the m-payment concept, the value propositions that would entice them to a) migrate and b) remain with a new MNO, and the barriers that would prohibit them from participating in the trial. Participants strongly favoured customer loyalty schemes that offered a range of options, instant or short-term rewards, and the ability to use the rewards with other branded goods and services. Key barriers to participating in the project included: top-up charges, the use of a low-end smartphone due to its limited functionality and the fear of technical errors at the POS.

Unfortunately, the project was officially terminated by the MNO in May this year as the testing phase highlighted a number of “customer experience issues” that could not be addressed in time for a third launch attempt. Nevertheless, the MNO honoured its commitment to provide the registered participants with a smartphone, as agreed from the out-set. The data gathered at the pre-launch phase suggests that there is need for the creation of a common language (i.e. ontology) and the development of a visualisation tool in order to support multiple stakeholders to address key

stakeholder issues at the early stage of forming a value-network and in conjunction with the envisaged business model. This new insight has prompted the authors to refine their face-to-face interview questions with the stakeholders in order to acquire a retrospective and multi-perspective understanding into the complex m-payments phenomenon.

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Denis Dennehy, Frederic Adam and Fergal Carton

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Using Bricolage to Facilitate Emergent Collectives in SMEs

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Abstract: Starting a new business is often done in a realm of improvisation if resources are scarce and the business horizon is far from clear. Strategic improvisation occurs when the design of novel activities unite. We conducted an investigation of so called 'emergent collectives' in the context of a small and medium-sized enterprise (SME). Emergent collectives are networks of information nodes with minimal central control and largely controlled by a protocol specification where people can add nodes to the network and have a social incentive to do so. We considered here emergent collectives around an enterprise resources planning (ERP) software and a customer relation management (CRM) software in two open source software (OSS) communities. We investigated how the use of bricolage in the context of a start-up microenterprise can facilitate the adoption of an information system (IS) based on emergent collectives. Bricolage is an improvisational approach that allows learning from concrete experience. In our case study we followed the inception of a new business initiative up to the implementation of an IS, during a period of two years. The case study covers both the usefulness of bricolage for strategic improvisation and for entrepreneurial activity in a knowledge-intensive new business. We adopted an interpretative research strategy and used participatory action research to conduct our inquiry. Our findings lead to the suggestion that emergent collectives can be moulded into a usable set of IS resources applicable in a microenterprise. However the success depends heavily on the ICT managerial and technological capabilities of the CEO and his individual commitment to the process of bricolage. Our findings also show that open ERP and CRM software are not passing delusions. These emergent collectives will not take over proprietary ERP and CRM software all of a sudden, but clearly the rules of the game are slowly changing due to the introduction of new business models. The study contributes to the research of OSS as emergent collectives, bricolage and IS adoption in SMEs.

Keywords: SMEs, bricolage, emergent collectives, open software, ERP, CRM, IS adoption

1. Introduction

Starting a new business is often done in a realm of improvisation if resources are scarce and the business horizon is far from clear. Start-ups and small- and medium-sized enterprises (SMEs) often adopt information technology (IT) and information systems (IS) in order to facilitate a start-up. However, adopting IT/IS into an embryonic organizational structure with a lack of rigid business processes is a complex and risky task. Many investments in IT/IS, such as Enterprise Resource Planning (ERP) or Customer Relation Management (CRM), outsourced as well as in-sourced, never fully reach the intended objectives and are therefore considered as not being successful. Despite our knowledge of IT/IS implementation, a lot of IT projects still fail (Avison et al. 2006, Devos et al. 2008, Bharadwaj et al. 2009, Group 2004). Past and recent research has also revealed that SMEs tend to lean strongly on external expertise for IT adoption (Thong et al. 1996, Dibbern and Heinzl 2009). IT outsourcing greatly increases the complexity of governing these endeavours and brings in new risks and burdens for IS success (Aubert et al. 2005). Although SMEs have specific characteristics like organizational flexibility, limited span of control and fast decision-making, the development of internal resources and capabilities for IS adoption is still a critical problem because SMEs are resource constraint (Raymond 1985).

In this work we intend to build on and move beyond existing work to provide conceptual underpinnings for the study of bricolage applied for adopting IT in a start-up enterprise. Bricolage is an improvisational approach that allows learning from concrete experience. We highlight the tension between the dominant view of classical governance models rooted in control theory and the alternative approach of bricolage. We discuss both the concept of bricolage and how a bricolage-based arrangement might be used into the organizational context of an SME. We adopted an interpretative research strategy and used participatory action research (PAR) to carry out our inquiry.

We conducted an investigation of emergent collectives in the context of a start-up. Emergent collectives are networks of information nodes with minimal central control and largely controlled by a protocol specification where people can add nodes to the network. Petrie (2011) refers to an emergent collective as an ant colony in which its behaviour, and intelligence is the result of the rather mindless interactions of individual ants following simple protocols of interaction that result in qualitatively different global behaviour (Petrie 2011). The motivation for collectively acting lays within the capacity of the networks to scale and to increase value for the user. We considered here the emergent collectives around an ERP software and a CRM software in two open source software (OSS) communities. We formulated our research question as: how can the use of bricolage facilitate the adoption of emergent collectives in an entrepreneurial setting? In a real life case we followed the inception of a new business initiative up to the implementation of an IS during a period of two years. The case study covers both the usefulness of bricolage for strategic improvisation and for the entrepreneurial activity in a knowledge-intensive new business.

This paper is structured in five main sections, starting with this introduction. In the following section we review the recent literature on bricolage and IT. In the third section we elaborate on our research methodology based on action research and we introduce the case study. In fourth section we bring the findings of our inquiries. Section five discusses the conclusions and implications of our work for academics and practitioners.

2. Bricolage

The concept of bricolage was introduced by the French anthropologist Lévi-Strauss in his book, *La pensée sauvage* published in 1962 and translated in English to *The Savage Mind* (Lévi-Strauss 1968). Bricolage is Lévi-Strauss's term to describe the mythical thinking of primitive people, who used a fixed set of ideas that they combined and recombined in different ways (Pohn 2003-2007). The word bricolage is French and does not have a precise equivalent in English. It can be translated as tinkering or playing/messing around. Lévi-Strauss uses bricolage as an analogy to spell out the processes underlying mythical thoughts (Duymedjian and Ruling 2010). The bricoleur is the handyman, tinkerer or do-it-yourselfer. It can be noticed that the words bricolage and bricoleur applies to playing and refers to devious actions. Lévi-Strauss (1968) compares bricolage as 'the science of the concrete' as opposed to logical thinking grounded in (positivistic) science and characterized bricolage as a particular way of acting as 'doing things with whatever is at hand'. The science of the concrete is characterized by a concern for exhaustive observation, systematic inventorying of all elements and relies on a highly developed mode of understanding based on the intimacy with the concrete (Duymedjian and Ruling 2010). The bricoleur is not a craftsman and bricolage does not proceed in a straightforward, linear and rational way. Instead bricolage wander from one thing to another and has a fragmented nature reflecting its affinity with play (Pohn 2003-2007). Being a bricoleur also means being a thinker tinkerer with focus on instant objects and materials at hand to approach solutions for problems faced (Coleman 2006). Bricolage is not very well articulated as a theory. Lévi-Strauss describes the process of bricolage through the role description of the bricoleur. In a dichotomous category the bricoleur is the opposed ideal-type of the engineer. From the seminal work of Lévi-Strauss, three constructs can be inferred to characterize bricolage: 1) *repertoire* or the material and immaterial resources that are collected independently of any particular project or utilization, 2) *dialogue* or the activity of assembling objects and 3) *outcome*, which's refers both to the process and its results (Duymedjian and Ruling 2010). Bricolage is related to improvisation, sensemaking, entrepreneurship and the work of technical systems (Duymedjian and Ruling 2010).

Bricolage was introduced in anthropology and found its way into cognitive sciences, Information Technology (Ferneley and Bell 2006, Johri 2011, DesAutels 2011, Ciborra 2002), Entrepreneurship (Phillips and Tracey 2007, Baker et al. 2003), Innovation Research (Fuglsang and Sorensen 2011, Banerjee and Campbell 2009), Information Sciences (Coleman 2006) and Organization Theory (Duymedjian and Ruling 2010, Weick 1998). In this work we elaborate on bricolage in IT. Pioneer of the research on bricolage and IT is Claudio Ciborra (Ciborra 2002). Ciborra (2002) criticized the way strategic thinking about IT in organizations is often presented as a linear, top-down, rational and cognitive process. When put into use by practitioners strategic planning is a process of disassociation from the theoretical foundations. The trajectory from IT strategy formulation down to implementation is not an intentional process of design, but a chain of evolutionary processes that involve serendipity and muddling through elements of surprise. The analysis of Ciborra (2002) is compliant with the phenomenon of emergent collectives (Petrie 2011). His example of the early launch of the Internet is most compelling: *...[.] ARPANET did not take off as expected and it was far from being an undisputed*

success. *What helped to transform a research network into the full-blown Internet was a myriad of hacks, surprises, and improvisations, mostly stemming from the users' environment, and the benevolent and tolerant ARPA project management practices* (Ciborra 2002). Ciborra (2002) introduces the concept of bricolage as an alternative for the systematic and procedural way of organizing and executing work. Bricolage, as opposed to the pre-planned way of operating can be highly effective since it can fit the contingencies of the moment. Ciborra (2002) poses that information systems have a high degree of flexibility in their use making them ideal for bricolage.

The resources at hand for IT bricolage are hardware and software artefacts. The IT bricoleur interacts with existing software, by redesigning, modifying and adding new functionality and by doing so, new ways of using the software are explored. Although it is common that bricolage is executed on an operational level, bricolage is also experienced in strategic action. The IT bricolage approach is very similar to the activities that can be observed in the emergent collectives of open source software (OSS) communities (Ferneley and Bell 2006). OSS users as well as developers work intimately together on requirements, try them out with tinkering to the code and in so doing a useful software can emerge. Examples of such OSSs are the communities of OpenERP (www.openerp.com) and MAGENTO (www.magento.org) which were used in the case study.

The instantiation of the concept of bricolage is suggested by seven oxymoron's (Ciborra 2002). These oxymoron's represent a systematic approach for the establishment of a new organizational setting where new systems can be adopted. The paradoxical reflections can provoke new ways of thinking and consideration. Each of the oxymoron's constitutes a thinking frame that excludes forms of established organizational routines and existing control systems. We developed here the oxymoron's as propositions of the theory of bricolage.

First oxymoron is *value bricolage strategically (VBS)*. The status of bricolage in an organization can balance between a highly competent behaviour and incompetence. The bricoleur operates in a fuzzy work zone that offers liberty and experimenting with the choices of which resources at hand will be used. The solutions that come out of the process of bricolage need to be embedded in an everyday experience and local knowledge as well as having a strategic impact. The second oxymoron is *design tinkering (DT)*. Prototyping and experimentation must be facilitated through arrangement of activities, settings and systems. Knowledge is generated through design and by creating actions, and actions are evaluated to build knowledge. Third oxymoron is *establish systematic serendipity (ESS)*. A climate for unexpected solutions must be provided through the concurrency of conception, implementation, and execution that intermingle constantly. Fourth oxymoron is *thrive on gradual breakthroughs (TGB)*. The emerging ideas and solutions must lead to managerial routines that helps to bring to new institute to the level of a simple organisational structure (Mintzberg 1993). Fifth oxymoron is *practise unskilled learning (PUL)*. Unlearning the old ways of thinking and challenging incremental learning while incorporating the risks of behaving incompetent. Sixth oxymoron is *strive for failure (SFF)*. Formative evaluation of failures can generate new ideas and designs. Striving for excellence is the summative evaluation of successes and does not lead to innovation or change. Finally the seventh oxymoron is *achieve collaborative inimitability (ACI)*. The activities of bricolage are highly idiosyncratic, often latent and are not easy to imitate. This can be seen as a vital source for competitive advantage for SMEs to remain agile and responsive to the business environment the inimitability should be the key for creating a competitive advantage but collaboration, even with competitors, in developing strategic applications should not be avoided.

3. Research methodology

This research projects aims at two goals: first we have to give an answer to a research question and second it has to fulfil a business need. Although the last goal is strictly not necessary to acquire scientific knowledge, it is part of our specific setup and research method. Therefore we adopted for our investigations PAR since we were dealing here with a complex social system that cannot be reduced for a meaning study (Baskerville 1999). Action research aims to solve current practical problems while expanding scientific knowledge (Baskerville and Myers 2004). We have worked with practitioners in a well chosen case study to solve an important practical problem: the adoption of an information system based on emergent collectives in an entrepreneurial start-up.

Since PAR was chosen as our research method, this involves that we are taking an interpretive stance of the research enquiry and that we are not aiming to a broad generalization of the results. According to Baskerville (1999) action research implies the adoption of an idiographic viewpoint. Also

the interpretative perspective of the research process, is aiming at making sense of the phenomenon's under investigation. In the quest for an answer to our research question we brought the theory of bricolage to a deeper stage of development and understanding. The use of theory in our research is threefold: 1) as a guide to design, 2) as an iterative process of data collection and analysis, and 3) as a final product (Walsham 2006). The setting up and carrying out of fieldwork is the fundamental basis of any interpretative study (Walsham 2006, Klein and Myers 1999). All actions of the researchers and the CEO were documented into logbooks. The findings of our actions were coded out of our descriptions in the logbooks. We used axial coding to relate the concepts in the descriptions with the theoretical proposition of the bricolage theory (Corbin and Strauss 2008).

For our research plan we drew on the action research process proposed by Baskerville (1999) and on the PAR used in the work of Street and Meister (2004). However we also differentiated our research plan slightly according to the specific situation we dealt with. Action research consist of a cyclic form of five phases. Figure 1 illustrates the action research cycle. The action research cycle can be performed as many times as needed for achieving a solution to the problem. We discussed within the research team on the number of cycles and decided to conduct only two cycles: a baseline analysis and an implementation cycle. The Client-System Infrastructure constitutes the agreement of our research environment. The structural action research cycle starts with the diagnosing phase which identifies the primary problems and leads to the theoretical assumptions of newly organization. In this phase the researchers interviewed the CEO during several session to understand the past, present, and future use of IT and how the CEO thinks IT could be beneficial for the organization.

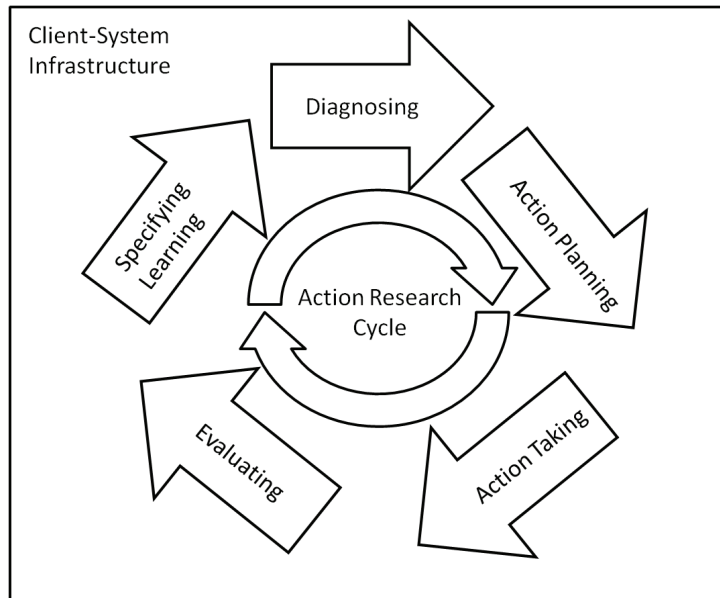


Figure 1: The action research cycle

The action planning phase contains the organizational actions that deal with the problems defined in the previous phase. The next stage is action taking and implements the planned actions. The intervention of the researchers is non-directive. The change is sought indirectly in process of cut-and-try. The test of the theoretical assumptions was done in the evaluating phase. The last phase is the specific learning phase in which lessons learned are derived.

Case Study Endoxa

Endoxa is a Greek word and was used by Aristotle to acknowledge the tested beliefs of a community. The CEO of Endoxa discovered a business opportunity which is similar to its existing operations. It is obvious that new e-business initiatives, but also existing ones, suffer largely from a shortage of logistic capabilities. In this new venture, Endoxa is aiming at becoming more than a drop shipping agent, but rather as a network orchestrator of the complete cross chain supply of delivering products to customers. To build the necessary supporting and enabling business processes for this new attempt, Endoxa adopts the vision of emergent collectives of OSS and will combine existing technologies into a new strategic information system. Although Endoxa is a very small entrepreneurial enterprise it is compliant with the five criteria defined by Mintzberg, to constitute a

minimal organization (Mintzberg 1983). There is direct supervision, little formalized behaviour, an organic structure, a strategy planning and the CEO formulate plans intuitively as an extension of his own personality.

Before the research project took off, the CEO of Endoxa was already involved in another research project on the nature of emergent collectives. As a serial entrepreneur the CEO was in search for assistance to see how OSS could be of use to start a new company. As researchers we had the chance to observe the take off of a new enterprise and this offered an excellent opportunity to enlarge our understanding of how IT/IS can be of critical importance in organisations. An agreement for a research partnership was formalized that stipulated the rights and obligations of the researchers and the CEO and his collaborators. The actions of the researchers were performed in an open way and were aiming at a beneficial impact on the organization. All actions were done in close harmony with the CEO. The CEO provides the necessary knowledge to the researchers for being harvested in an academic inquiry. However both parties had their objectives. It was clear from the beginning that the CEO was aiming at a fruitful start-up for his enterprise. The objectives of the researchers were spelled out in the research question. The design of the artefact is for the researchers is only a means to an end. The theory or concept of bricolage was explained to the CEO, however the concept of emergent collectives was very well known to the CEO.

4. Findings

First it was noticed that the stages of the action cycles do not always proceed in linear and straight forward way. The appearance of the organisational actions is concurrent and not always synchronised. It was the task of the researchers to shed light on the different actions and make an appropriate analysis of the findings. We summarized our findings in table 1, showing the findings during the baseline analysis cycle and in table 2, showing the findings during the Implementation cycle.

During the first team meetings with the CEO ten actions were identified, starting from an overall company mission that was spelled out in a proposal (BRIDEE) and submitted to a business school. The overall company mission was detailed in a competitor's analysis, a market research plan, a business and a financial model. Two specific actions, e-AirwayBill and polling quotes Fedex were defined as nice-to-haves but it was in no way sure that the implementation was feasible within Endoxa. The choice for OpenERP and Magento was fixed and the organisational modelling was done with these two products as mission critical systems. OpenERP was suggested as the back-office solution and Magento as the front-office solution. Finally a project was set up for the acquirement of government subsidies for a new start-up initiative.

For the action planning an agenda was set up to work on each of the actions during two days a week. The researchers got mingled with the CEO and the collaborators of Endoxa and for each action a planning was made. The action planning and action taking are also shown in table 1. The theory building is mainly inferred from the evaluating and learning phases. For the bottom line we found five actions that were classified as Value Bricolage Strategically (VBS). These five actions, the Mission Statement, the Competitors Analysis, the Market Research Plan, the Business and the Financial Model can be seen as the transformed stakeholders needs into an enterprise's actionable strategy. However the down-top translation is not feasible into specific goals at every area of the enterprise. The actions were considered as strategic but still subject to modifications and adaptations.

Two specific actions, e-AirwayBill and Polling Quotes Fedex were classified as Design Tinkering (DT) and Practise Unskillful Learning (PUL). It was designing something that was already in use. The lesson learned was that it is better to use what is already build and proven than to make something new. This is actually compliant with the resource constrains in SMEs.

The actions OpenERP and Magento where of major importance for Endoxa and there was a tense force coming from the CEO to strive for a breakthrough. This illustrates that an ERP system is mission critical in SMEs and perceived as such by the CEO. The basic business processes like invoicing, general ledger, accounts receivable and payable as well as the more strategic processes like tendering, sales, order entry and bidding need to come together in one integrated system. Proprietary ERP software was not an option for Endoxa, because of the costs. The actions were considered to be a match with the oxymoron of Thrive for Gradual Breakthroughs (TGB). The strive for subsidies was already considered by the CEO as not feasible due to a shortage of manpower and administrative

agility. Still the action was kept open in the hope that a file could be submitted for a positive evaluation. This action was classified as a Thrive for Failure (TFF). The end of the first cycle and the start of the second cycle did not follow a linear trajectory. During the baseline cycle, already actions were defined for the implementation cycle. The implementation cycle was characterised by much more diagnosed actions as can be seen in table 2. The actions OpenERP and Magento were considered as the most imported actions of the cycle and were matched with five oxymoron's of bricolage: VBS, DT, ACI, SFF and PUL.

5. Conclusions

In this paper we present the findings from a participatory action research describing how bricolage can facilitate the adoption of emergent collectives in the form of OSS in a microenterprise. The use of the PAR helped us to make our research more relevant to practice. We argue that our work differs with that of consultants. Our theoretical perspective of bricolage was made clear in advance and before any action was taken in the organization. We mapped the practical actions with the propositions of the theory of bricolage, operationalized by the oxymoron's. The relationships between the elements of created artefact are made more visible than previously during the actions. Our understanding of the constructs of bricolage has been increased.

Our research has revealed the pivotal roles of the CEO in which IT/IS is adopted and implemented. A positive attitude of the CEO towards IT/IS was noticeable during the entire investigation period. This is compliant with previous research on the role of the CEO and the adoption of IT/IS (Cragg and King 1993, Thong et al. 1996). However different roles of the CEO could be observed: first of all the role of the owner-manager which always kept a sharp look on the profitability of the endeavour and the strategic focus. Secondly the role of an individual high-end user who was intimately involved into the daily use of the software in all the implemented business processes. Thirdly the role of CIO and IT manager who steered the project of bricolage and utilized the mechanism of IT project management like organizing steering committees meetings, communications session for the users, and documenting the actions and realizations of the project members.

From our findings it could be noticed that the process of bricolage was sometimes getting in the way of the daily business operations. Since Endoxa is a start-up this was not so important but this indicates that the process of bricolage need to come to a moderate intensity to reduce the organisational turbulence and to refocus on organisational efficiency. It was already noticed by Ferneley et al. (2006) that IS bricolage is not without its dangers: *"the entropy of the IS can increase as changes are made, rendering the IS architecture unmanageable and inefficient"*. Bricoleurs and certainly entrepreneurial bricoleurs have to keep in mind that the process of bricolage should take place within the boundaries of a minimal organisational structure (Weick 1993). Also at a certain point after the change process is established, a phase of entropy-reducing is needed to allow the new systems to take off and to fade away the organisational turbulence.

It has been shown that OSS in ERP and CRM type application domains, where conventional wisdom says it is impossible to design from an open software perspective, holds a valuable promise. Many software project leaders would not dare to choose for OSS in an entrepreneurial setting and would prefer propriety software stating that the quality of the latter one is far more superior than open source. Although we did not investigate that statement, in our empirical findings we found evidence that the development of an information system with OSS is certainly not a straightforward process, nor that the development process is free from errors and flaws, but this is no way other than for propriety software. By choosing for OSS the SMEs has avoided the vendor lock inn that comes all too often with the adoption of propriety software and has reduced the total cost of ownership of the information system. A rough estimate has revealed that the cost of implementation of OpenERP comes to the same high as a feasibility study for a mainstream propriety ERP vendor.

Table 1: The baseline analysis cycle

	Diagnosing	Action Planning	Action Taking	Evaluating	Specifying Learning
1	BRIDEE	Spelling out the mission statement?	Submitting for a business school competition.	VBS	Mission statement needs refinement but is not mandatory for a bottom up 'bricolage' approach.

2	Competitors Analysis	List of three direct competitors was edited (big 3): Shipwire, Shipworks and Easyshipping.	Investigation of the support of the web shop platforms of each the 'big 3'.	VBS	The obtained information was used as a benchmark for the own realizations.
	Diagnosing	Action Planning	Action Taking	Evaluating	Specifying Learning
3	Market Research Plan	What are the questions that web shops have considering their logistic processes.	Offering a platform for the support of the logistic processes of web shops	VBS	To fuzzy to be of real value
4	Business Model	A sound business model	Refining and adapting the business model to current insights and developments	VBS	To fuzzy to be of real value
5	Financial Model	Calculating financial flows, cash flows, OPEX and CAPEX.	Comparing the figures with partners and competitors	VBS	To fuzzy to be of real value
6	e-AirwayBill	Visualize the XML-structure of the transport documents.	Testing	DT, PUL	Never build what is already build by others.
7	polling quotes Fedex	How to use Web Services in logistic processes	Test account with Fedex	DT, PUL	Never build what is already build by others.
8	OpenERP	All business processes should be implemented in OpenERP	Adopting the full set of functions of OpenERP	TGB	The CEO had a strong belief in open software products and the use of OpenErp was mandatory.
9	Magento	All logistics processes of the web shops should be implemented in Magento.	Adopting the full set of functions of Magento	TGB	The CEO had a strong belief in open software products and the use of Magento was mandatory.
10	Strive for Subsidies	Research on three levels: Regional, National and European.	Try to work through the rigor government procedures for subsidies	SFF	Subsidies programs are not easy accessible for SMEs. The bureaucratic burden is to heavy.

Table 2: The implementation cycle

	Diagnosing	Action Planning	Action Taking	Evaluating	Specifying Learning
1	OpenERP	Scheduling of Mailers Version upgrading Geotags EBay module, Inventory Management, Warehousing Extract Transfer Load User and access rights The company 'OpenERP'	Feasible solution found in OpenERP Upgrade v.6.0.3 to v.6.1 was successfully implemented Module is available, however not stable Module is available, deployment is put on hold Implement	DT ACI SFF PUL DT VBS	OpenERP offers a solution The upgrade to the latest version is a pioneering activity and is not yet followed by most competitors Not all fancy tools are needed and useful Resources are constraint

			Follow up of the company 'OpenERP': company visits.		Design up to a workable system The SME organisation is still dependent of the evolution of the opener OSS.
	Diagnosing	Action Planning	Action Taking	Evaluating	Specifying Learning
2	Magento	MagentoERPConnect (connection with OpenERP) Dropshipping scenario	Installing, configuring and testing	DT	Assurance that Magento is of use
3	polling quotes Fedex	Feasibility study	Obtain shipping quotes from Fedex	DT, VBS	Connection to Fedex is of strategic importance
4	Operations	Daily routines & procedures for backup and recovery	Deploy	DT	Operations can be implemented in a OSS environment
5	IceCAT	Feasibility study	Installing and testing	SFF	A lot of offerings in a OSS are of no use
6	Bista Solutions	Alternative for the module of drop shipping in OpenERP	Investigate the feasibility	DT, VBS	Multiple sourcing for the acquisition of IT
7	Wiki	Documentation tool for the tools in the repertoire Not for the business processes: The documentation for the business processes should be into OpenERP	Structuring is needed to create real value	PUL	Documentation is real problem for IS implementation projects.
8	Competition	ShipWire ShipEasy ShipWorks	Constant focus on their activities	VBS	Keep up with the pace of the competitors

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Determining the Maturity Level of eCommerce in South African SMEs

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Abstract: According to the United Nations (2002: 14) report on eCommerce adoption and diffusion in South Africa, South Africa is one of 55 countries at stage 3 of the McKay, Prananto and Marshall's (2000, 3) model, namely the interactive stage. This means that it hosts a more sophisticated level of formal interactions between users and service providers, via e-mail and post comments. (United Nations, 2002: 15). Molla and Licker (2004: 91, 92) found that 83% of the SMEs surveyed owned websites. According to the Global Diffusion of the Internet (GDI) criteria, these figures suggest that SA is at a medium stage of eCommerce maturity, neither immature nor fully mature (Molla and Licker, 2004: 91, 92). In an attempt to measure the maturity levels of South African SMEs a checklist, based on stages of development models, was developed using six relevant frameworks/models/classifications identified using a quantitative research methodology and positivist approach. The overall finding of the research was that South African SMEs are at stage 2 maturity of the McKay *et al*, (2000, 3) model, namely an experimental online presence stage.

Keywords: SME's, eCommerce, stages of development, web site functionality, maturity, checklist

1. Introduction

The pervasive nature of the internet has changed the way in which countries conduct business worldwide. Since its emergence in the 1990's, eCommerce has quickly become the way of conducting business on a global scale (Cloete, 2002: 2). Of particular interest in the field of eCommerce is its proliferation in small businesses. In South Africa there are between 1.6 and 3 million SMEs and they contribute 30% to the country's GDP (Motjoloane and Warden, 2007: 3; Berry *et al* 2002: 13). There are as many definitions for an SME as there are views on their characteristics. (Gamage, 2003; Gilmore, Gallagher and Henry, 2007 and Cloete, 2002b). For the purpose of this paper the definition of an SME is one that complies with the requirements of the South African National Small Business Amendment Act, No 26 of 2003. The Act lists a number of requirements that need to be met in order to be classified as a SME. For the retail and wholesale sector these are: number of employees: 50, total annual turnover (sector dependent): between R6m to R13m, and total gross asset value (fixed property exclude): R3m.

The statistical accuracy for any SME study, including the actual number of SMEs in South Africa, is low as a large number of SMEs, at least three quarters, are in the informal sector of business and so are essentially legally unrecognized (Berry *et al*, 2002: 12). Accuracy aside, it is not disputed that SMEs play a critical role in any economy and their ability to conduct eCommerce is of prime importance to ensure their active inclusion in the new economy. The use or level of progression of eCommerce in SMEs has typically been studied and adoption encouraged. SMEs generally face unique and challenging barriers that have inevitably affected the level of adoption or assimilation of eCommerce into daily operations. This laggard approach to eCommerce adoption is a characteristic of developing countries. In South Africa, it was suggested that the available technologies are not adopted to the extent that is necessary for survival in the current business environment (Cloete, 2002: 3; Kruger, 2007: 4).

Research in eCommerce adoption usually concentrates on factors that affect adoption, barriers and stage models (Mohamad and Ismail, 2009: 3, 4). Many maturity models have been proposed for eCommerce diffusion, with varying approaches and focus points. Mahdi and Steinmueller (2002: 2) highlighted two classifications of approaches to determining eCommerce diffusion; the application approach and the organizational approach. The application approach delves into the tools of eCommerce, such as websites and the adoption of information and communication technologies (ICT). The organisational approach, in contrast, focuses on the softer and subjective matters surrounding the adoption of eCommerce, such as the direct relationship between the owner's attitude towards ICT and the level of adoption and diffusion of eCommerce. The former approach is adopted for this paper and recognises that as eCommerce activities continue to accelerate in the economic environment, there is an increasingly important need for scholarly identification and analysis of the input factors in the design of a website, to enhance the quality of that website, which is believed to

positively affect eCommerce diffusion (Chang, Kirk and Litecky, 2001: 125). A quantitative research methodology was used in this study and a positivist approach employed.

Companies, particularly SMEs, can enter the eCommerce arena at different levels of sophistication. Sophistication refers to the information, processes, structures and skills adopted by a company for facilitating transactions online. Some SMEs enter as 'brochure-ware' sites as the first step in creating a web presence. Others use the internet as a means of conducting business, taking sales orders online and processing payments offline. Yet others engage in relatively more complex operations, such as offering online catalogues, receiving online orders and handling online payments. Recently websites have begun to employ newer technologies and features, such as blogs, RSS and alternate payment processes to enhance the shopping experiences of their customers (Ally, Cater-Steel and Toleman, 2007: 1009).

The research findings will hopefully propel further research into eCommerce methods enabling policy makers to recommend solutions and initiatives to improve South Africa's current SMEs eCommerce maturity rating.

2. Research premise

The overall research question was "What is the eCommerce maturity level of South African SMEs based on their websites information content, functionality and sophistication?"

Typically, the initial step is the development of static websites where no prior programming knowledge is required. The next stage of development provides functionality which helps in customers' decision making (such as order catalogues). As the eCommerce experience increases, databases are introduced and the website becomes dynamic and increasingly interactive. This is followed by personalisation, customization, search functions etc. indicating a higher level of sophistication of a website (Fisher *et al*, 2007: 255). Beck, Wigand and Konig (2005: 38) state that websites can be categorised according to technical measures of what is included in them and how they function. The argument being that more sophisticated websites will include applications such as email, online transaction facilities, and customer service or support.

Ally *et al*, (2007, 1010) proposed that the several "stages of development models" like E-Commerce Maturity Model (KPMG, 1997), Commitment-Implementation Matrix Model (Stroud, 1998), the eCommerce Levels (O'Connor and Gavin, 1998), Business Lifecycle Model (Berryman, 1999), Intranet Maturity Model (Dastard and Schemers, 1999), eCommerce Adoption Model (Daniel *et al*. 2022) and the Stages of Growth for business Model (Pregnant *et al*, 2002), classified a web site by comparing its functionality to an eCommerce capability and activity list.

Six relevant frameworks/models/classifications were identified to determine the most prevalent functionalities, features and content used to evaluate websites of any industry type. These were:

- The Centre for Electronic Commerce (CEC) website evaluation framework.
- Model of Internet Commerce Adoption (MICA) (Walcott, 2007),
- The extended Model of Internet Commerce Adoption (emic) (Doolin *et al*, 2002),
- Ally *et al*'s. (2007) 5 stage model,
- Doolin *et al*'s. (2002) 14 levels of functionality,
- Garcia-Boboli *et al*'s (2005) three web presence classifications.

Each framework/model/classification framework/model/checklist was analyzed according to the level of sophistication, functionality, interactivity and complexity of implementation by a content element or content feature, shown in Table 1. The premise being that as websites build on either complexity or sophistication, so the features and functional components of the site increase (Burgess *et al*, 2009: 522) indicating the maturity level of eCommerce in SMEs. Ally *et al*, (2007: 1011) proposed that an evaluation and assessment of an organisation's website against a framework will determine the level at which an organisation currently stands. It indicates the organisation's maturity at a particular point in time.

Table 1: Comparison of functionality and features and identified Website Checklists

Functionality/ Feature	CEC	MICA	eMICA	Ally <i>et al</i>	Doolin <i>et al</i>	Garcia-Borbolla <i>et al</i>
Advertising	X		X	X		
Order form			X		X	
Online payment	X	X		X	X	
Offline payment				X		
Email	X	X	X	X	X	X
Shopping cart				X		
Minimum security	X		X	X	X	
Customer registration and login				X		
Order tracking	X	X	X	X		
Advanced security				X		
Customizability	X		X	X		
Links		X				X
Enquiry	X	X	X		X	
Technical information		X				
Promotion	X	X	X			
Catalogue	X		X			X
Contact information	X		X			
Customer support (FAQs, sitemaps)	X	X	X			X
Chat room, discussion groups, blog	X		X	X		
Multimedia	X		X	X	X	
Feedback, Polls	X			X		
Database search	X			X		X
QuickLinks	X	X				
Pricing information	X					X
RSS feed	X					X
Company information	X	X				X
Customer policies	X					
Help function	X					
Links to distributors		X			X	
Graphic/Images				X	X	X
Cookies				X		
Instant Messaging				X		
History						X

3. Website evaluation checklist

A checklist was constructed by comparing and contrasting the differences in the identified quantitative website frameworks/models/checklists, shown in table 1. The checklist was classified into 3 content areas based on our interpretation of how the checklist item relates to the research of Ho (1997) and Burgess and Cooper (2000):

- Static content, which is synonymous to a simple or formal or ornamental presence on the web.
- Static content is informational in nature and relatively low in sophistication (largely imitative and inspired by novelty of innovation) in terms of the programming and technical expertise.
- Interactive content that groups the features and functions that support transactions between the buyer and the SME, facilitated online.
- Transactional content that groups the features and functions that facilitate communication, be it internally (within the SME's boundaries) or externally.

3.1 Static content

Company Information: This broad term refers to information such as the company's mission statement, financial information, and history. This is usually found in the section called 'about us' or the home tab/page of a typical website. Garcia-Borbolla *et al*, (2005: 175) state that this type of information does not have a specific target audience and so serves a promotional purpose.

Contact Information: This is considered basic information pertaining to the physical address, email contact and other contact detail, such as telephone and fax numbers (Doolin *et al*, 2000). The aim of this section is to show the communicative technologies that the SME makes use of.

Pricing Information: The prices of the products and/or services provided must be present in the website. This is representative of the SMEs willingness to attract sales from their audience and thus marks the first step towards online transactional activities (Garcia-Borbolla *et al*, 2009: 181; Gwetu, 2005: 63).

Product Catalogue: This may be viewed as a virtual version of a leaflet/brochure. Promotional activities, such as advertising and promotions (for specials etc.), are encompassed in this feature (Garcia-Borbolla *et al*, 2005: 176).

Graphics/Images: This refers to the simple 2 dimensional graphics and images that support the aesthetic or design appeal of the website (Fisher *et al*, 2007: 256).

3.2 Transactional content

Order Form: facilitates online ordering where the user enters all the information needed to successfully complete an order.

Online payment option: a site that has online purchasing capacity to allow *payment offline or online*. The latter is more complex and sophisticated to implement and monitor, is now more prevalent with organisations especially with the introduction of stringent security measures.

Offline payment option: This applies when the banking details for payment have been supplied on the site alongside contact information to confirm payment. The promotional activities all take place online but the final payment step is done offline.

Shopping cart: This is used to keep the history of the user's saved purchases and facilitates what is termed '2-click purchasing' (Elliot *et al*, 2000: 14).

Security: A policy document or lock on transaction data, not only on credit cards are evaluated (Elliot *et al*, 2000: 14). There are no distinguishing between advanced and basic security settings in this study. It is suggested that encryption and privacy seals should be used to assure security and privacy of online shopping.

Order tracking: This is an after sale procedure and ensures that the user has order confirmation, delivery time and trust assurance (Elliot *et al*, 2000: 14).

3.3 Interactive content

Email facilities: the provision of email facilities as part of the website (for real-time contact with the business) is more sophisticated than a static email addresses mentioned in the contact us page.\

Customer registration and login: this is a feature found in most sites and it is the threshold for exploration of many of the other functional components (personalization and access) mentioned in this proposed framework (Grant and Pearson, 2010: 185).

Customisability and personalization: This is an enhanced customer service that facilitates personalization of the layout, design, history, features, applications etc. (Elliot *et al*, 2000: 14). The ability to provide a personalized, customized interaction for the user allows for website design that differentiates product and service offerings (Green and Pearson, 2010: 186).

Links to social media sites: This is a new feature introduced in this study. This is in recognition of the movement towards online communities and collaborative online tools facilitated by Web 2.0. The inclusion of links to social media demonstrates the recognition of the marketing opportunities afforded by social networking. An example would be a link to social networking sites Facebook and LinkedIn (Gilmore, 2011: 1).

User groups: Chat rooms, blogs, and discussion groups are included in websites in the bid to create online communities. This can also be used as a form of feedback for the hosts of the websites (Elliot *et al*, 2000: 14).

Multimedia: This may be novel or expert use of multimedia items such as audio, video, 3D graphics and animations.

Polls: Polls allow users to vote on issues and influence the organization's decision making on issues such as policies and service delivery. They are a form of feedback and demonstrate a SME's willingness to partner with users (Gwetu, 2005: 64).

Search Engine: This enables the user to perform a search for words on all site pages while database search enables queries of information that exists in the database, an example would be a search for a specific staff member (Gwetu, 2009: 63).

QuickLinks: These are menu based links that take one to other parts of the site. This is a convenient navigational feature in the website (Gwetu, 2009: 63).

RSS Feeds: This can be in the form of news headlines or blog entries. It is a highly interactive feature (Walcott, 2007: 266).

Help function: Help serves as a convenience and ease of use tool that improves not only the learnability of the website but also user experience (Elliot *et al*, 2000: 4).

Newsletters: the provision of electronic newsletters.

Links to Distributors: This is considered a broader approach to customer services as the idea of integration is introduced. The website provides links to upstream or downstream partner websites (Elliot *et al*, 2000: 14)

Customer support: Burgess and Cooper (2000) consider customer support mechanisms, used to facilitate an improved customer experience, are of medium interactivity in terms maturity levels. FAQs and sitemaps are examples (Elliot *et al*, 2000: 14).

4. Sample selection

As this research forms part of an IS Honours dissertation, a sample of 300 randomly selected SMEs' were identified from two online SME directories; Metropolitan SME repository and Small Business directory. These two directories are diverse both in size, BEE status and economic sector. The website "<http://www.SMEportal.com/allcompanies>" contains each SME's product, company profile and supplies the website link. The second source, Small Business directory (<http://www.smallbusinessdirectory.co.za/>) serves the same purpose but differs in categorising the SMEs by business sector instead of by name. Of the identified 300 SMEs only 30 had working websites sites. However there were some websites that had links disabled, these web sites were not considered.

5. Weighting

To eliminate the emphasis on certain features the checklist features and functionalities were not weighted. Elliot *et al*, (2000: 8) suggests that discussions about differing levels of importance for categories tends to distract attention from the main issue, this being the sophistication of websites to ascertain the intensity of eCommerce use of websites. If the element in the checklist was present 'at an acceptable level', then a single point is awarded. If the element is not present, no point is awarded. A more elaborate assessment could have been developed, like the use of a five-point Lickert scale for each element. However, there are inconsistencies inherent in the approach and the variation in the evaluation framework reduces the reliability of the instrument (Elliot *et al*, 2000: 8).

6. Findings and analysis

6.1 Static content

The frequency of static content present in the surveyed SME websites is shown in Figure 1. The results show that all the sampled websites have product advertising. This supports the premise that SMEs websites are essentially digital brochures or catalogues. 97% of the sampled websites had graphics or images. Only 47% of the websites evaluated had pricing information for their products and /or services. More than half of the sites advertised without pricing information. These sites predominantly had enquiry or “request quote” email facilities to attain pricing information. Unexpected findings were a low 33% frequency of company history and high 81% frequency for other contacts information.

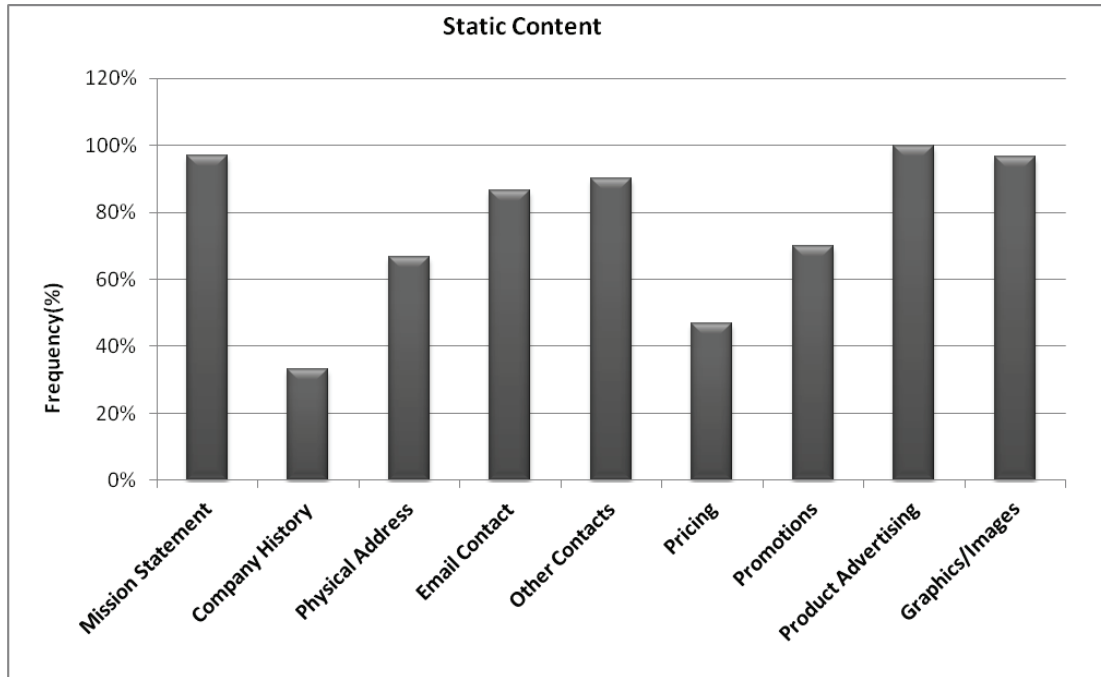


Figure 1: Frequency of static content in SME websites

6.2 Transactional content

20 out of the 30 sampled websites had no transactional content. The most commonly used feature in all the websites with transactional content was an order form, to make either online or offline orders. This feature is relatively easy to implement (Gwetu, 2009: 65) as opposed to the online shopping features. This is particularly disconcerting as the majority of websites evaluated were for businesses that sold tangible products that could be traded online. However, Mahdi and Steinmueller (2002: 11-12) state that the implementation of transactions is a function that some SMEs choose to avoid regardless of the level of their experience (Mahdi and Steinmueller, 2002: 11-12).

The low frequencies for transactional content (even a 0% for the emerging mobile payment method: electronic wallet), suggest that SMEs avoid features that are difficult to implement and monitor, possibly due to the security and backend obligations involved (Walcott, 2007: 265). SMEs, even though they are perceived largely entrepreneurial in a business context, portray a somewhat risk averse in their attitude towards the implementation of complex features on their websites (Gwetu, 2009: 65). In addition, from the simplistic definition of eCommerce, which states that it is the purchasing and selling of products online, the lack of transactional content in SME websites in essence means they do not facilitate eCommerce (Yeung and Lu, 2002: 487). Figure 2 (below) illustrates the findings pertaining to transactional content of the sampled websites.

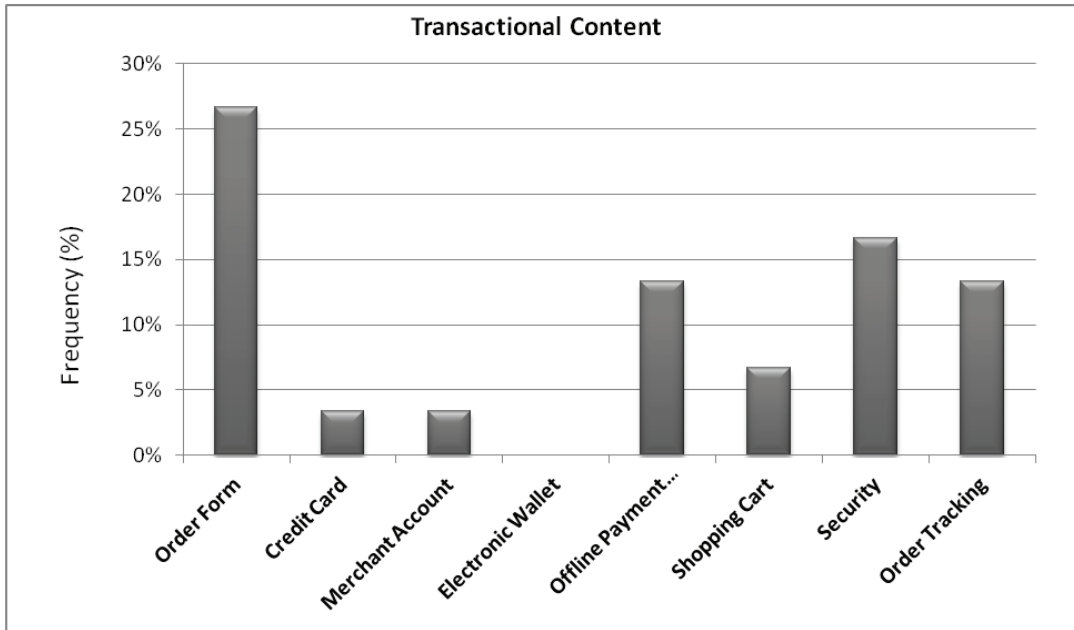


Figure 2: Frequency of transactional content in SME websites

6.3 Interactive content

Figure 3 depicts the frequency of the interactive features and functionalities used on the websites. The results show that 87% of the websites have email facilities or links for enquiries. The remaining 13% either have no email contact or have one in a 'contact us' sections. Of concern is that only 17% of the websites have links to social sites, even though this feature is easy to implement on a website (Gilmore, 2011: 1). The universal appeal and nature of social sites and their extended use as a marketing and feedback tool in the corporate environment, this makes it an essential and inexpensive tool for the growth of SMEs (DiMicco et al, 2008: 712; Gilmore, 2011: 1).

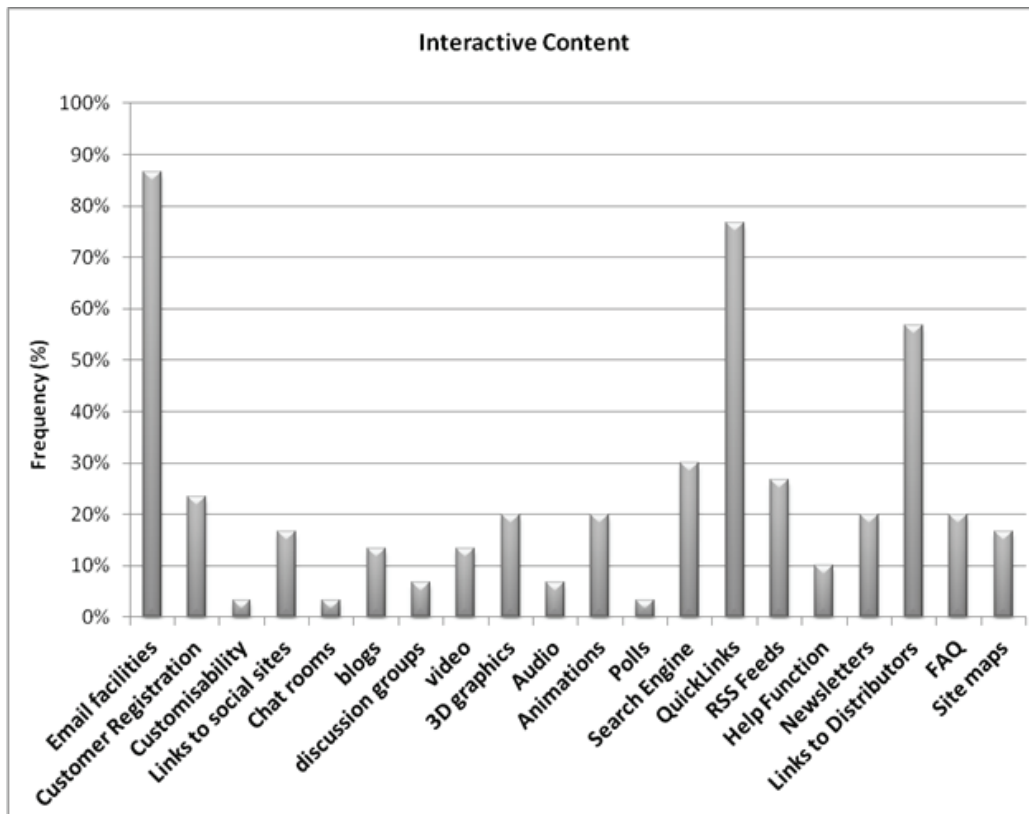


Figure 3: Frequency of interactive content in SME websites

Aside from navigational features, such as links to distributors (57%) and QuickLinks (77%), all the websites evaluated scored below 30% on interactive features. Most of the websites only had email facilities and QuickLinks as interactive features. The use of audio and video features is extremely low on the surveyed websites. Search engines, be it Word or site search, was 30%. This low percentage could be indicative of the websites consisting of only a few pages of content, thus reducing the justification for a search engine. These results reveal that currently SMEs put more emphasis on informational content as opposed to interactive features (Gwetu, 2009: 65).

7. Maturity level of eCommerce based on results of the survey

Currently, by most developing countries standards, South Africa has an advanced ICT infrastructure. This, however, even though it may have translated into an increase in adoption of IT by businesses, does not translate into a high maturity level for eCommerce (Molla *et al*, 2006: 6; Atrostic, 1999: 96). The above survey results indicate that most of the websites host static content implying that South African SMEs are at stage 2 maturity based on the stage models of McKay *et al*, (2000: 3), Ho (1997) and Burgess and Cooper (2000). These findings suggest that these SMEs are still experimenting with online presence and this is reflected in the low maturity rating. Stockdale and Standing (2006: 386) term this phase “paddling, where SMEs are likely to have email and internet connection but are hesitant to exploit these technologies to their full potential”.

Additional findings are the sampled SME websites were predominantly composed of static content. Two thirds of the sampled websites had no transactional content and little interactive content. The sophistication and quality of the websites was low. The percentage of SMEs possessing a website was low when considering the total number of website links and SME searches (over 300 searches) that were performed in the process of applying the checklist. 70% of the surveyed SMEs had no transactional and/or interactive features at the same time. The fact that the SMEs surveyed host websites had low sophistication and hardly any quality content reinforced the finding of a low eCommerce maturity level. The maturity level of eCommerce implemented by the SMEs in the South African retail and wholesale sector should be addressed as only a small percentage of SMEs have more than a simplistic web presence online. In a study conducted in year 2000, only 1% of the sampled SMEs had achieved an integrated eCommerce status. This figure was predicted to increase to 36% by the end of 2004 (Molla and Heeks, 2007: 94). The findings of this research do not support this projection. The findings of this research support the premise that eCommerce is not an agenda item for most SA SMEs with websites.

8. Conclusion

The paper, and the research in general, has attempted to find a method of measuring the maturity levels of South African SMEs by using a checklist based on the stages of growth model. Initial indications are that this method of research could be quite valuable as it overcomes several of the shortcomings of current honours degree academic research like the short time frame for honours degree research, non-return of questionnaires, different interpretations of survey questions, etc. Further research and validation on the derived checklist is currently being undertaken.

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David Freeme and Portia Gumedede

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Advancing GeoMarketing Analyses with Improved Spatio-temporal Distribution of Population at High Resolution

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Abstract: Knowing the spatiotemporal distribution of population at the local level is fundamental for many applications, including risk management, health and environmental studies, territorial planning and management, and GeoMarketing. Census figures register where people reside and usually sleep, and are frequently the only data source available for such analyses. Currently, the analysis of service areas and population served is mostly made considering only census data as source of population distribution, while some businesses clearly serve mostly a daytime population. However, population density is not constant within census enumeration areas. Also, due to human activities, population counts and their distribution vary widely from nighttime to daytime, especially in metropolitan areas, and this variation is not captured by census data. Raster dasymetric mapping within geographic modeling allows transforming raw population counts to population density limited to specific areas where the variable is present, in more detailed temporal periods, by using ancillary data sets and zonal interpolation. In GeoMarketing, this information is especially useful for retail sales, banking, insurance, lodging, real estate, and franchising. These refined distributions can be used to improve such analyses as site selection, service area and population served, assessment of potential markets, routing activities, location-allocation, and gravity models. This study uses such a dasymetric mapping approach for detailed modeling and mapping of the spatiotemporal distribution of population in the daily cycle. These data sets are used to assess the location and the varying population contained in the service areas of existing and prospective commercial facilities in the daily cycle, for different types of businesses. Applications in GeoMarketing using spatial analysis are illustrated for three different scenarios involving private sector services where maximizing coverage of target population is paramount for success. The case studies show that when the spatiotemporal distribution of population is considered, the obtained set of solutions differs from the one produced by using census-based data alone. The results demonstrate that enhancing population distribution data through geographical modeling can greatly benefit spatial analysis in GeoMarketing, resulting in the production of better information that ultimately allows improved decision-making.

Keywords: GeoMarketing, population distribution, dasymetric mapping, service area, maximum coverage, Oeiras

1. Introduction

1.1 GeoMarketing as a structured process

GeoMarketing is a fairly recent discipline that combines the power of geographic visualization and analysis with Marketing techniques and insight, aiming at more efficiently attaining the ultimate goal of the latter: to sell products, services, or ideas. Although the concept of marketing mix has long included 'Place' among the four 'Ps' (others being Product, Price, and Promotion) (McCarthy 1960), its importance has been underestimated in formal technical analyses that support decision-making. Driving the need for GeoMarketing is the basic premise that markets vary from place to place (and with time) and that business strategies should take this fact into account. For many businesses, the decision of where to locate their commercial outlets will be the most important determinant of their success.

The emergence of GeoMarketing was facilitated by advancements in the spatial analysis and visualization capabilities of Geographic Information Systems (GIS), but their usefulness for conducting studies in business and economics remains to be fully explored (Cheng et al. 2007; Mishra 2009). As a structured *process* supporting decision-making, GeoMarketing analyses are more than a simple task, instead involving the following sequential steps: (1) formulating the problem, (2) obtaining and processing the required data, (3) conducting the analysis, and (4) producing conclusions and recommendations. Spatial and non-spatial data sets are required to characterize both the supply (facilities, service, product, competitors) and the demand (population, existing and potential customers) in a given market. However, as with every information system, the quality of the results is never higher than the accuracy of the input data used.

Concerning their geographical scale or scope, analyses can be conducted at four levels: (i) continental, (ii) national (among countries), (iii) regional (comparing regions or cities), or (iv) local (within a city or settlement). Regarding the required socioeconomic data (including demographic) to match these levels of analyses, (i) and (ii) require country-level totals, (iii) demands data by municipalities or communes, while (iv) requires disaggregated data that represent intra-urban variations.

1.2 The relevance of population distribution for GeoMarketing

Knowing the spatiotemporal distribution of population at the local level is fundamental for many applications, including risk management, health and environmental studies, territorial planning and management, and also GeoMarketing (Freire 2010). The capability of obtaining accurate simple population totals within the service area is often a basic indicator of potential demand for a service and corresponding financial success, especially for those which have a local demand and serve the immediate neighborhood.

A typical problem for GeoMarketing has been how to best locate a commercial facility in order to maximize the potential customer coverage and therefore profit (Jeong et al. 2008). Conducting such an analysis requires as a minimum data on population/potential customer distribution and information concerning the business. However, there is a surprising lack of academic research studying the importance of demographic data for such analyses and testing more advanced data sources beyond those solely based on the census.

Census figures register where people reside and usually sleep, and are frequently the only data source available for such analyses. Currently, the analysis of service areas and population served in Portugal and many countries is made considering only residence-based (nighttime) census data as source of population distribution, while some businesses clearly serve mostly a daytime population. However, population density is not constant within census enumeration areas, although it is commonly represented as such. Also, due to human activities, population counts and their distribution vary widely from nighttime to daytime, especially in metropolitan areas, and may be misrepresented by census data.

Geographic modeling and dasymetric mapping allows re-distributing population to specific areas where it is present in more detailed temporal periods, by using ancillary data and zonal interpolation (Eicher and Brewer 2001). In GeoMarketing, this information is especially useful for retail sales, banking, insurance, lodging, real estate, and franchising. These refined distributions can be used to improve such analyses as site selection, service area and population served, assessment of potential markets, routing activities, location-allocation, and gravity models.

The present work aims at presenting the development of a dasymetric mapping approach for detailed modeling and mapping of the spatiotemporal distribution of population in the daily cycle, and demonstrating its value for improving geographical analyses in GeoMarketing. Applications using spatial analysis are illustrated for three different scenarios involving private sector services where maximizing population served (i.e. potential demand) is paramount for success.

2. Study area and data

2.1 Study area

Detailed spatiotemporal population modeling was performed for Oeiras and Cascais, two of the eighteen municipalities that comprise the Lisbon Metropolitan Area (LMA), the main metropolitan area in Portugal. Demonstrations of applications of these data sets in Geomarketing analyses are implemented in the municipality of Oeiras (Figure 1). This municipality occupies 46 km² and has a resident population of 162,128. Density of resident population varies significantly throughout the study area, from high density in multi-story apartments to low-density in rural areas. Even at the census block group level, some polygons are enormous and do not reflect their uneven population density. Despite the 'gravitational pull' of the adjacent city of Lisbon (the national capital), Oeiras recently created several technological and office parks and has acquired an intensive tertiary activity. Therefore daytime population displays distinct spatial distribution and densities from the census, totaling 148,937 people.

This area has ideal characteristics for this study, namely with regard to urban and suburban character and presence of strong economic activity.

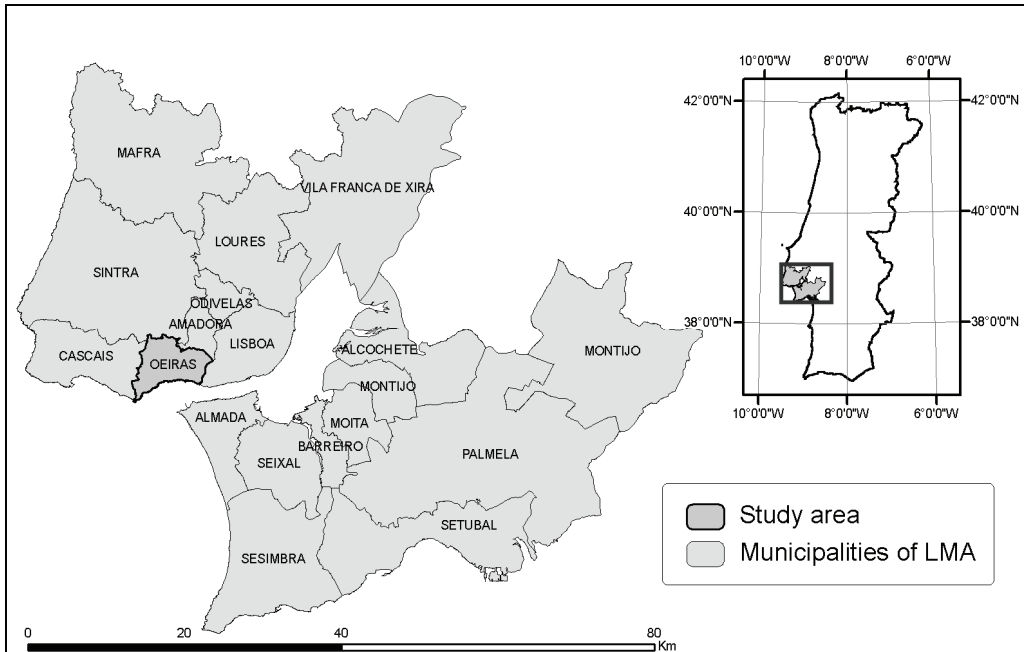


Figure 1: Location of the study area in Portugal and in the Lisbon Metropolitan Area

2.2 Data

Input variables used for modeling population distribution include both physiographic and statistical data. In the first group are census tracts, street centerlines and land use and land cover (LULC), while the second includes census counts (INE 2001), data on workforce by workplaces, and commuting statistics (INE 2003) for the study area. These data were obtained from various sources and in different formats which are listed in Table 1. The target year for modeling population density is 2001.

Table 1: Main input datasets used for modeling nighttime and daytime population

Data set	Source	Date	Data type
Street centerlines	Private	2004	Vector polyline
LULC (COS90; CLC2000)	Public	1990; 2000	Vector polygon
Census block groups	Public	2001	Vector polygon
Census statistics	Public	2001	Database (MS Access)
Workplaces and employment	Public	2001	Table
Commuting statistics	Public	2001	Table (O/D matrix)

COS90 is a digital LULC map at the scale 1:25,000 covering almost the entire country, however it dates from 1990. Therefore, to ensure temporal consistency among input data sets, it was decided to update it to some extent using the more recent CORINE Land Cover database for the year 2000.

3. Geographic modeling and analysis

The methodology was implemented in a Geographic Information System (GIS) and includes two main stages: a) modeling spatiotemporal population distribution and b) building and analyzing sample Geomarketing applications.

3.1 Modeling spatiotemporal population distributions

The modeling of population distribution is based on dasymetric mapping using street centerlines as spatial reference unit to allocate population counts. The most recent statistical and census data (2001) provide the population counts for each daily period, while physiographic data sets define the spatial units (i.e., grid cells) used to disaggregate those counts. This general approach was proposed by the Los Alamos National Laboratory (New Mexico, USA) to map daytime and nighttime population distributions in the US at 250-m resolution (McPherson and Brown 2003), and is adapted and applied to Portugal.

The map of nighttime population distribution was obtained by using a grid binary dasymetric mapping method to disaggregate residential population from census zones to residential streets. First, available digital LULC maps were improved, relevant classes selected, and combined, in order to identify residential land use. Street centerlines were also modified in order to better represent the road network existing in 2001. Then, freeways are removed from consideration and the resulting eligible streets are combined with residential land use classes from LULC data to obtain residential streets. These are subsequently rasterized at 25 m and the population from census block groups (source zones) are interpolated to the respective residential street cells (target zones) using areal weighting

The modeling of daytime population distribution considers mobility statistics. It results from the combination of two components: a) the daytime population in their places of work or study – the workforce population surface, and b) the population that remains home during the day - the daytime residential population grid. The latter is obtained by multiplying the nighttime distribution by the percentage of resident population who, according to official statistics (INE 2003), does not commute to work or school. In the absence of other information, it is assumed that non-commuters remain in their residences in the daytime period. The workforce population surface was created by georeferencing 2167 workplaces and schools and respective workforce and students in the study area. 562 of these facilities were georeferenced manually using ancillary data and field work. The remainder workplaces were geocoded to the street centerlines using their addresses.

Using this methodology, four raster population distribution surfaces were produced, at 25 m resolution: (i) nighttime (residential) population (Figure 2), (ii) daytime residential population, (iii) daytime worker and student population, and (iv) total daytime population (Figure 3). Additionally, an *ambient* population surface is produced by computing a weighted average of nighttime and daytime distributions, considering the proportion of nighttime and daytime periods occurring in a typical 7-day weekly cycle.

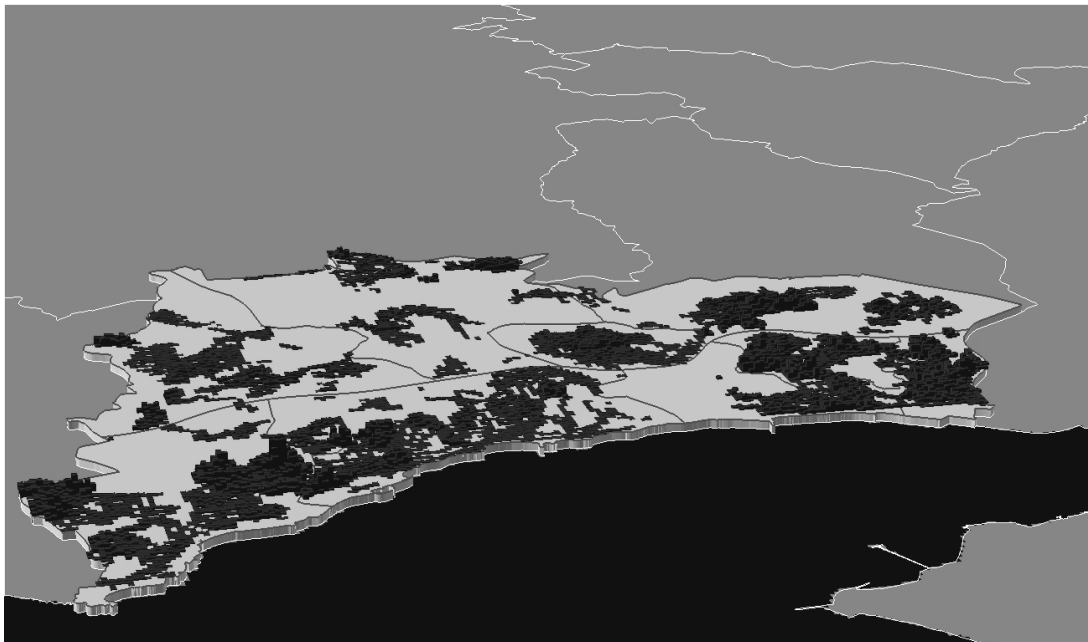


Figure 2: Grid of nighttime population distribution in Oeiras in 3D

The resulting 25-m population grids were subsequently aggregated to 50 m cells for analysis and visualization purposes, thus representing densities by 2,500 m² (0.25 ha). The nighttime distribution was validated using the higher-resolution census blocks units as reference (i.e. ground truth) in a correlation analysis. A correlation coefficient (Pearson's *r*) of 0.79 was obtained, showing a good performance of the model. Additional details on the population distribution modeling are provided in Freire (2010).

This method also efficiently accommodates people that work at home, by not assuming that all active population leaves their residences during the workday. The main value of these results includes the increased spatial resolution of nighttime distribution (higher than census data), the fact that both

nighttime and daytime distributions share the same spatial reference basis (therefore support cell-by-cell comparison, and that previously unavailable daytime distribution is represented.

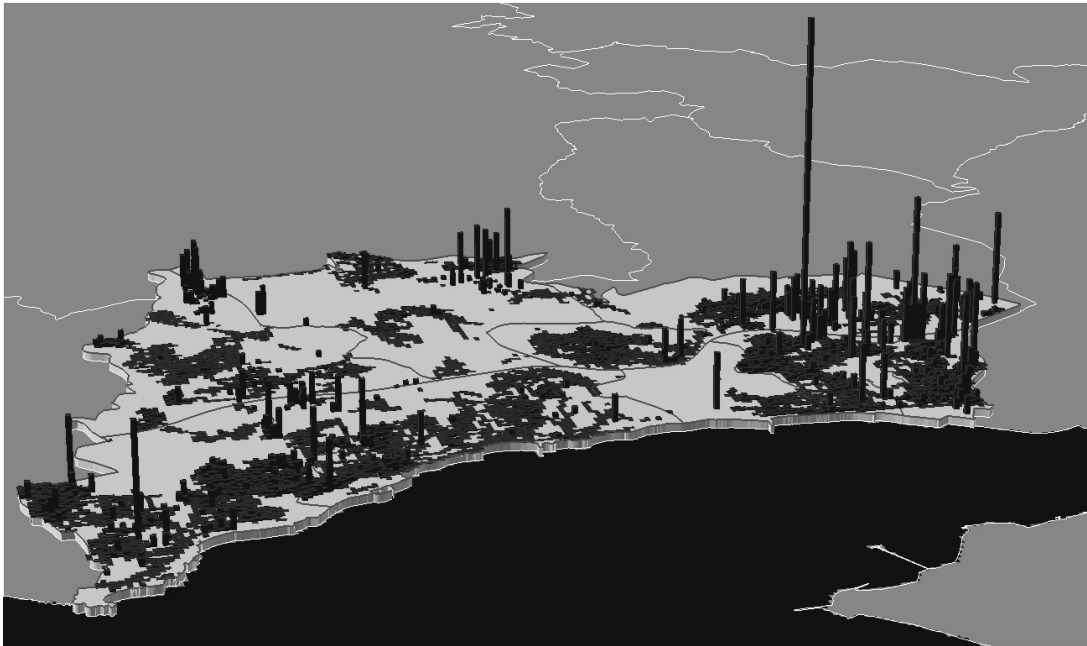


Figure 3: Grid of daytime population distribution in Oeiras in 3D

3.2 Sample applications to GeoMarketing

For demonstrating the usefulness of detailed spatiotemporal population in GeoMarketing, three typical sample applications using demographic analysis are illustrated in the municipality of Oeiras. One application concerns quantifying the actual coverage for an existing network of facilities, whereas the other two applications concern expansion and location planning, aiming at selecting the *optimum* location (in practice the best) for new facilities, considering both their target demographics and hours of operation.

The scenarios involve types of business services having local influence and markets, therefore the service areas are based on accessibility over the street network, computed considering either metric distance or time. Although the business data are fictitious, the remaining data analyses are real and accurate.

3.2.1 Case study A: Assessing population served by existing facilities network

A bank wants to quantify the current population coverage for its existing network of four branches in the municipality of Oeiras (Figure 4). Accessibility is measured in metric distance and a 1-km service area is defined for each facility, using the road network.

Figure 5 illustrates assessment of served population using the nighttime distribution (A) and the daytime distribution (B).

Results of the assessment of served population within the service areas (Table 2) show a quite different outcome obtained with each of the two surfaces in terms of raw figures and ranking of facilities. While based on the census-like nighttime distribution, facility #3 serves the most people (4372) and facility #4 the least, using the population surface that matches banks' daytime operating hours it is facility #1 which serves the most people (8618) and facility #3 the least. Overall, 19173 people are served by the four facilities considering their daytime distribution, compared to 13073 when the assessment uses the residential distribution alone.

3.2.2 Case study B: Site selection for daytime service

A restaurant chain operates two profitable facilities and wishes to open a third facility in the vicinity. Since this business targets mostly a local market due to their quick service and affordable meals, it makes sense to measure accessibility as time and define its core service area as being within five

minutes walking distance (Figure 6). Among the two locations available for expansion (#1 and #2), which one has the most population and potential within its service area?



Figure 4: Case study A: locations of existing banking facilities

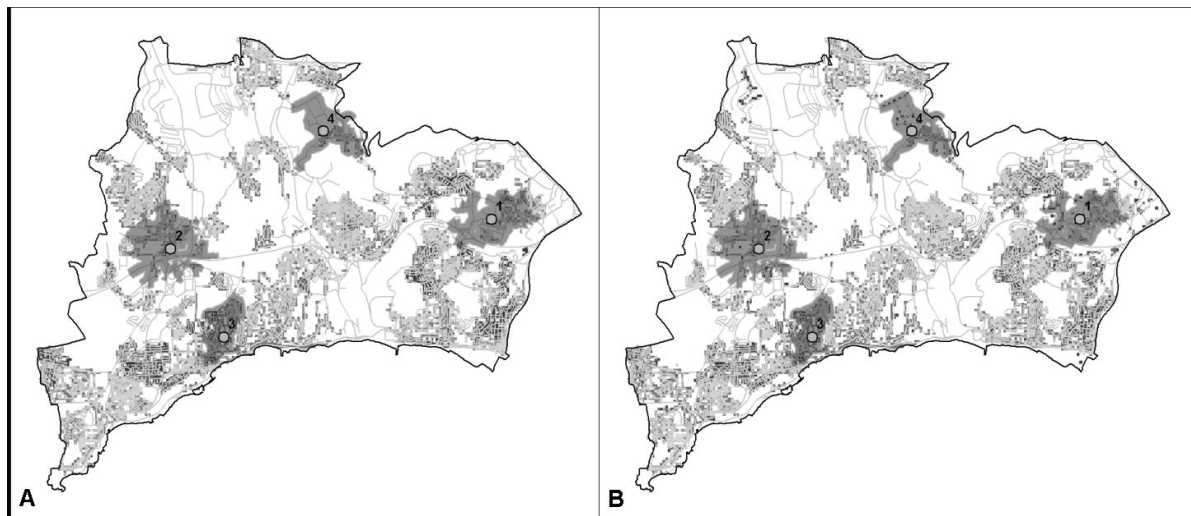


Figure 5: Potential customers assessed using the nighttime distribution (A) and the daytime worker and student population (B)

Table 2: Population served and ranking of banking facilities using the nighttime and daytime population

Facility #	Nighttime		Daytime	
	Population	Rank	Population	Rank
1	4250	2	8618	1
2	3714	3	3220	3
3	4372	1	3202	4
4	737	4	4133	2
Total	13073	--	19173	--



Figure 6: Case study B: existing (#3, #4) and prospective locations (#1, #2) and their service areas

Figure 7 shows a comparison of potential customers for the prospective locations assessed using the nighttime distribution (A) and the daytime worker and student population (B).

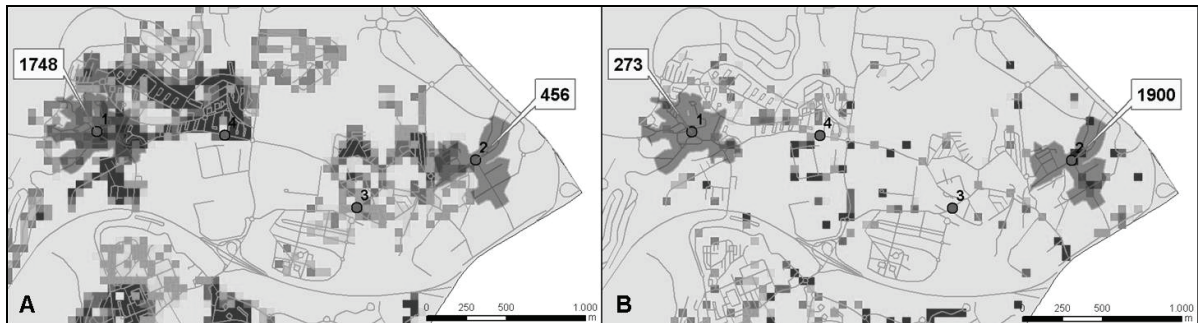


Figure 7: Potential customers assessed using the nighttime distribution (A) and the daytime worker and student population (B) grids

Whereas site #1 serves the most people in nighttime (1748), these are local residents less likely to be regular customers. Using the daytime worker and student population for analysis (i.e. the target demographics) shows that instead site #2 serves the most potential customers (1900 vs. 273).

3.2.3 Case study C: Site selection for daytime and nighttime business

Among three potential locations, a movie rental chain wants to select one site for expansion. Since this is a proximity-based business, accessibility can be measured as time and the service area defined by a five-minute walking distance (Figure 8). Extending its operating hours late into the night, this business targets both *displaced* (workers and students) and residential customers, in the daytime and nighttime periods.



Figure 8: Case study C: prospective locations and respective service areas

Figure 9 shows a comparison of potential customers within their service areas using the nighttime distribution (A) and the ambient population (B) surfaces.

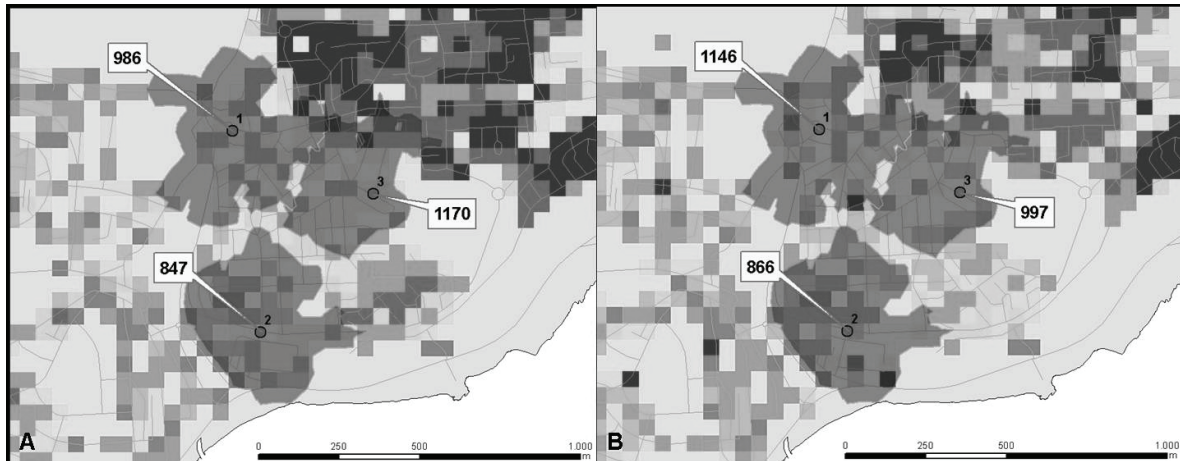


Figure 9: Potential customers assessed using the nighttime (A) and the ambient population (B) grids

The analysis shows that location #3 would serve the most people in nighttime (1170). However, when the daytime population is *also* considered (via the ambient population grid) in order to account for the daytime and nighttime hours of operation, location #1 emerges as having the greatest potential.

These case studies demonstrate that GeoMarketing analyses relying solely on census-based data (nighttime) for characterization of population served and business potential could misestimate the prospective customer base contained in the service areas and indicate a solution with less potential for success.

4. Conclusions

In metropolitan areas, the population distribution and densities are not static, varying significantly in the daily cycle. Knowing and using the spatiotemporal distribution of population at the local level can greatly increase the quality of basic spatial analyses in GeoMarketing. An approach was presented that allows combining existing geographic information with official statistics to model and map nighttime and daytime population distribution at high spatial resolution, able to support local-level analysis. The model integrates location of workplaces and schools with daily commuting statistics. The segmentation of daytime distribution into residential and worker and student grids further benefits GeoMarketing analyses. Three sample applications of these population data sets were presented, considering the nature of the business activity, their target demographics and hours of operation. Results show that using population distribution data disaggregated in space and time can significantly increase the detail and accuracy of spatial analysis, having the potential to greatly improve studies in GeoMarketing.

Future developments should focus on: better modeling of 'distributed activities' (e.g., cleaning, security), and accounting for people present in transportation networks or involved in leisure and shopping activities; increased temporal segmentations of population distribution, so as to represent differences on a weekly basis (workdays vs. week-end) or on a seasonal basis (winter vs. summer); and the use of statistical sources beyond census demographics to consider tourism influx in areas and periods where that activity is important.

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Activity Theory: A Useful Evaluation Methodology for the Role of Information Systems in Collaborative Activity

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Abstract: The way in which information systems are used in organisations has evolved over time. While they were initially used primarily for information processing and for supporting company centric efficiencies, they are now extensively used to share information and to support collaboration both internally within an organization and with external customers, suppliers and partners. While much IS research heretofore has concentrated on how information systems facilitate information processing and the decision making of individuals in an organisation, there is a growing need within organisations to analyse and understand how information systems facilitate both internal and external information sharing and collaboration. This paper provides an overview of activity theory and argues that this theory provides a holistic and insightful evaluation methodology which will allow researchers to investigate how collaboration is achieved through all elements of IS (people, process, technology). The key characteristics of activity theory that underpin its suitability for researching collaboration through IS are outlined. Finally, a specific example of future research using this theory is described.

Keywords: activity theory, evaluation methodology, information systems, collaboration

1. Introduction

Historically, information systems were utilised within an organisation's boundaries to minimise operating costs and to improve the efficiency of internal business processes (Alter 1992; Mukherji 2002). The conceptualisation of the extended enterprise and boundary-less organisation encouraged managers to broaden their search for efficiencies and discover new ways of creating value from their supplier network and beyond (Elliott 2001; Prahalad and Ramaswamy 2002).

Indeed, the commercial diffusion of the Internet in the 1990s completely overhauled inter-organisational integration as companies began to integrate Internet technologies with their existing information systems by connecting a web front-end to their internal applications (Ash and Burn 2003; Legner 2008). Externally focused information systems known as Inter-organisational Information Systems (IOS) emerged that transcended organisational boundaries (Hong 2002; Shin 2006) and enabled information sharing between organisations over the Internet (Bakos 1991; Majchrzak *et al.* 2000). The increasing role of web-based technologies to support all aspects of a company's business operations (i.e. electronic business or e-business) has been widely acknowledged both by the research community (Cagliano *et al.* 2005; cf. Evans and Wurster 1999) and by practitioners – for example: e-business reports have been published by many of the large consulting firms including Forrester Group (cf. Johnson 2003) and Morgan Stanley (cf. Witter 1999).

It is common to think of e-business as digitally enabled information sharing to support co-ordination and collaboration in three main areas: (i) within a business which focuses on supporting corporate activities and the integration of departmental activities; (ii) between a business and its channel partners (e.g. suppliers, distributors, or retailers); and (iii) between a business and consumers, which includes electronic shopping, product marketing, information retrieval, entertainment and client service activities (Shaw *et al.* 1997; Wu *et al.* 2003).

In relation to the co-ordination within a business, organisational effectiveness comes from information sharing to leverage intellect and knowledge in order to achieve corporate objectives rather than focusing on economies of scale in operations or physical sources of advantages (Ash and Burn 2003; Venkatraman and Henderson 1998). The ability of organisations to make processes effective is increasingly supported by intranets that facilitate team-level co-ordination (to achieve team objectives) and exchange of information and knowledge (Thomas and Bostrom 2010; Venkatraman and Henderson 1998). With respect to co-ordination and information sharing between a business and its channel partners, business-to-business e-commerce refers to transactions and information sharing to facilitate collaborative processes between organisations within supply chains (Cullen and Webster 2007; Mahadevan 2003). Regarding the interface between a business and consumers, because the web enables organisations to support a high level of client interaction (Straub and Watson 2001), it offers a unique opportunity to collaborate with individual clients in order to customise products and services for them (Straub and Watson 2001; Venkatraman and Henderson 1998). This ability offers

many benefits to an organization, including increased client satisfaction and client loyalty (Piller and Muller 2004; Wind and Rangaswamy 2001) as well as an opportunity to protect against commoditisation through differentiation (Piller and Muller 2004; cf. Wind and Rangaswamy 2001).

Bearing in mind this growing orientation towards the use of information systems to enable collaborative activity (both internally and externally), this paper argues that Activity Theory provides a very useful conceptual framework for evaluating how effective information systems are within this context. Section 2 provides an overview of Activity Theory. Section 3 discusses the growing use of Activity Theory within a number of fields, including the IS field. Section 4 discusses the views of Activity Theory on the use of technological and non-technological tools in collaborative activities. Finally, the appropriateness of activity theory for evaluating the use of information systems in collaborative activities, both within and outside the enterprise, is discussed (Section 5).

2. Overview of activity theory

The theory of activity (Engeström 1987; cf. Leont'ev 1978; Vygotsky 1978) is rooted in cultural-historical psychology and may be defined as a “*philosophical and cross-disciplinary framework for studying different forms of human practices as development processes, with both individual and social levels interlinked at the same time*” (Kuutti 1996, p. 25). Activity theory has its origins in the Vygotskyian (1978) concept of artefact-mediated and object-oriented action whereby human beings’ interactions with their environment are not direct, but instead the interaction between a human individual and the objects of the environment is mediated by cultural tools (see Figure 1).

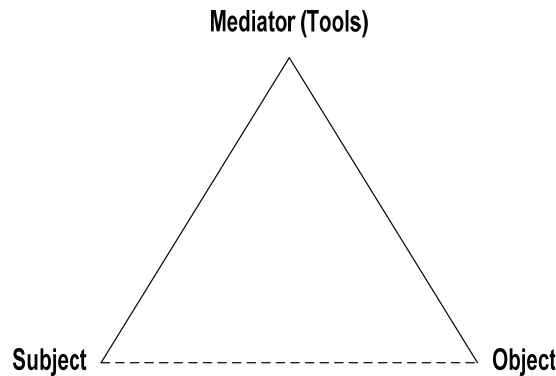


Figure 1: Mediation model (Vygotsky 1978)

Leont'ev (1978) further developed Vygotsky's ideas of social and cultural mediation by developing a hierarchical model of human activity. He argued that: (i) a minimal meaningful context for individual actions must be included in the basic unit of analysis (i.e. an activity); and (ii) because the context is included in the unit of analysis, the object of research is always essentially collective, even if the main research interest is in individual actions (Kuutti 1996).

Inspired by this, Engeström (1987) introduced an expanded version of the mediation model to reflect the collective and collaborative nature of human activity. Engeström's representation of an activity system (see Figure 2) depicts the relationship between three key elements of an activity. These are: (i) the subject of an activity; (ii) other actors involved in the activity (i.e. the community); and (iii) the shared object of the activity in which they are jointly engaged. These elements are represented by the inner triangle drawn with broken lines in this figure.

Figure 2 also illustrates three contextual factors that mediate these relationships – represented by the extremities of the outer triangle in the figure. They are: (i) roles/responsibilities (i.e. the division of labour between the subject and all other actors involved in the activity); (ii) rules/norms (i.e. explicit governing regulations and implicit social/cultural norms); and (iii) tools (i.e. concepts, instruments, language, signs, technologies).

These elements of the model mediate the relationship between a subject, other actors involved in the activity (i.e. their work community) and their shared object. Furthermore, the mediating role/rule/tool artefacts may be created or transformed during the development of the activity and carry with them a particular culture and historical residue of that development (Engeström and Miettinen 1999a).

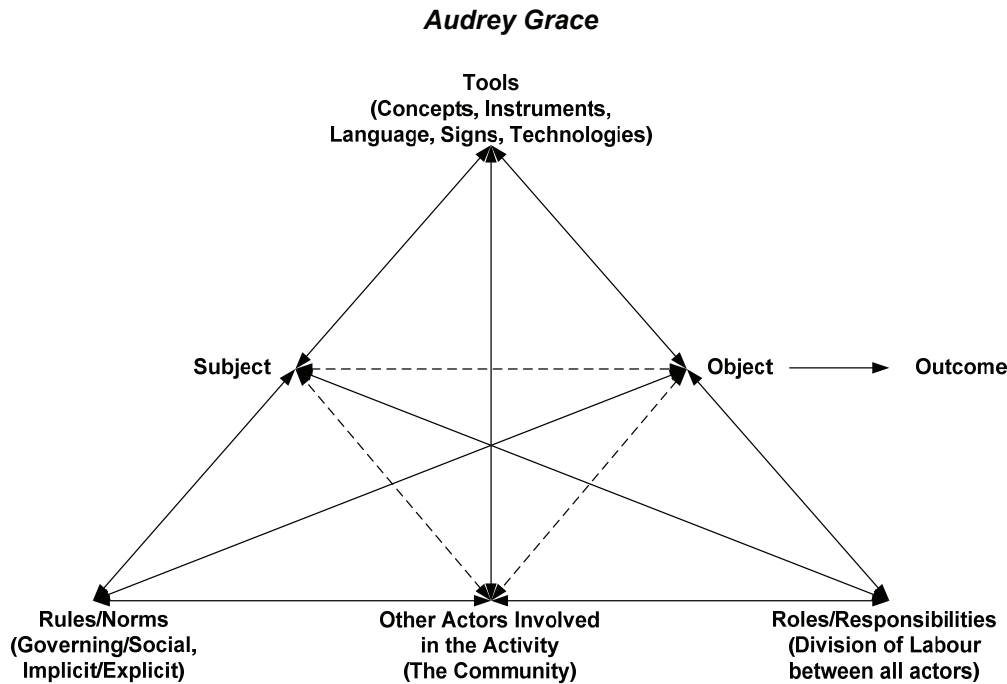


Figure 2: The activity system, adapted from Engeström (1987)

Activity theory holds that the human mind emerges, exists and can only be understood within the context of human interaction with the world; and that this interaction (i.e. the activity) is socially and culturally determined (Engeström 1999b). Activities are considered inherently dynamic because outcomes are characterised in terms of their dual individual and social existence in the consciousness of the performing subject.

Even though some individuals may be more powerful in the collective activity, no one individual can completely impose his or her view on other persons taking part in the activity. Because of this, it is useful to view the perspectives of different subjects within the activity, when analysing an activity (Boer *et al.* 2002; Virkkunen and Kuutti 2000).

An activity does not exist in a vacuum. Instead it exists as a node in a multi-dimensional network of activity systems (Engeström 1992). In the network around a 'central' activity, there are typically such activities as: (i) the object activity/activities (e.g. an object to be further transformed in the value chain); (ii) supervisory activities (e.g. where rules or division of labour for an activity are defined or rearranged; and (iii) support activities (Engeström 1992; Kuutti and Molin-Juustila 1998), for example: where tools and processes for an activity are developed or refined. The activity theory approach emphasises the incoherencies, inconsistencies and tensions that exist within an activity system itself and between an activity system and a neighbouring activity in its network (cf. Engeström 1987; Wiredu and Sorensen 2006). As a result, an activity system is constantly developing and working through tensions within and between its components and is also evolving collectively with other activity systems in the network.

3. Growing popularity of activity theory

Activity theory which was first introduced to the IS community by Bodker (1989; 1991) has the potential to inform a much broader perspective on real-life uses of technology than the traditional cognitive approach (cf. Kaptelinin and Nardi 2006; Korpela *et al.* 2004; Kuutti 1991). Activity theory provides a very useful analytical framework for understanding and analysing the mediation of human activities by both technological and non-technological artefacts (Bardram 1998a).

In recent years, activity theory has been applied extensively to research in the field of information systems (cf. Anthony 2012; Hasan and Gould 2001; Huang 2011). Activity theory is also becoming increasingly popular in a number of other fields. For example it has been extensively used in the field of human-computer interaction (cf. Bannon and Bodker 1991; Mwanza 2002) and computer-supported cooperative work (cf. Collins *et al.* 2002; Korpela and Soriyan 1998).

Researchers have also widely drawn upon this theory in studies on organisational learning (cf. Ahonen and Virkkunen 2003; Engeström 2004) and electronic learning (cf. Kaptelinin and Cole 2002).

Several international journals have published special issues devoted to studies based on activity theory, including the Scandinavian Journal of Information Systems in 2000, Computer Supported Cooperative Work in 1999 and 2002 and Interacting with Computers in 2003.

4. Activity theory on the use of tools

According to Activity Theory, a tool or artifact provides a means or instrument for carrying out an activity (Mwanza 2002; Wertsch 1997). Tools embody cultural knowledge (Kuutti 1996) as well as the formalisation of work practices (Christiansen 1996). They are collectively generated and maintained (Kaptelinin and Nardi 2006). Furthermore, the context of an activity and the individual habits of the subject may encourage the use of one tool over another (Wertsch 1997).

Tools can expand our possibilities to manipulate and transform different objects, but on the other hand, the object may be perceived and manipulated within the limitations set by the tool (Bannon 1997). Thus, a particular tool may be both enabling and limiting in that it provides a set of options from established patterns of achieving the object of the activity, yet it restricts the interaction to be from the perspective of that particular tool (Kuutti 1996; Wertsch 1997). Put simply, a tool works well in our activity if it allows us to focus our attention on the real object and badly if it doesn't (Bannon and Bodker 1991).

Furthermore, Bannon and Bodker emphasise that tools should only be considered from the perspective of their context (i.e. their actual use). Referring to the notebooks of Samuel Butler (1835-1902), they cite his example of a complex machine, if intended for use by children, ceases to be a tool and becomes a toy. They add that "*it is seriousness of aim and recognition of suitability for the achievement of that aim and not anything in the tool itself that makes the tool*" (Bannon and Bodker 1991, p. 227).

Following the work of Vygotsky (1978), Engeström (1987) distinguishes between technical tools which are directed toward the control of processes of nature and psychological tools/signs which are directed toward the mastery or control of behavioural processes. Examples of psychological tools and their complex systems include: language, various systems for counting, schemes and conventional signs (Vygotsky 1978). Technical tools include physical instruments or artefacts and may be either technological or non-technological.

Following the work of Latour (1993), Kaptelinin (1996b) emphasises that the role of technical tools is not limited to transmission of operational aspects of human interaction with the world. He argues that implicit goals built into technical tools can also shape the goals of the people who use these tools. Technical tools serve the double purpose of both doing something for you and reminding you of something you can do (Christiansen 1996).

Activity theory holds that tacit knowledge is gradually formalised into culturally created technological artefacts and that these artefacts mediate subsequent iterations of the activity (Kaptelinin *et al.* 1999). Engeström (1999b) also puts forward the notion that technical tools or mediating artefacts are integral and inseparable components of human functioning. The idea is that humans can control their own behaviour – not 'from the inside', on the basis of biological urges, but 'from the outside', using and creating artefacts (Engeström 1999b). He asserts that this perspective presents an opportunity for the "*serious study of artefacts as integral and inseparable components of human functioning*" (Engeström 1999b, p. 29).

5. Discussion and conclusions

Activity theory provides an insightful evaluation methodology that will help to improve our scholarly understanding of how information systems enable information sharing and collaboration both within the enterprise and across enterprise boundaries for a number of reasons (see Table 1).

First, the 'people/process/technology' nature of the Information Systems (cf. Duff and Assad 1980; Keen 1993) is captured in activity theory (see Section 2). In addition, activity theory also incorporates a pragmatic focus on how the objective of the collaborative activity is achieved through these three elements of IS. Activity theory, thus, provides an excellent conceptual vehicle for evaluating how technological information systems enable the objectives of collaborative activities to be reached while also remaining cognisant of the collaborative roles that people play in the activity and the rules/norms that guide these individuals as they interact together to achieve particular goals.

Table 1: Usefulness of activity theory for analysing how IS supports collaborative activity

Characteristic of Activity Theory (AT)	Relevance to how IS facilitates Collaborative Activity	Potential Future Research
AT provides a conceptual framework that allows researchers to analyse how three mediating factors (rules, roles & tools) mediate the relationship between a subject, other actors involved in a collaborative activity and their shared objective (Engeström 1987)	Incorporates the three key elements of IS (i.e. people, process and technology) with a strong emphasis on how the objective of the collaborative activity is achieved	Use the collaborative activity as the basic unit of analysis in order to analyse how the objective of a collaborative activity is enabled through people, process and technology
AT focuses on information sharing in a system rather than individual information processing (Korpela <i>et al.</i> 2004)	Collaborative activities, by their nature, are underpinned by information sharing (Jagdev and Thoben 2001; Sarker <i>et al.</i> 2000)	Use AT to specifically investigate how information systems facilitate information sharing between people involved in a particular collaborative activity
AT incorporates both technological and non-technological tools (Kuutti 1991)	There is clear evidence that information systems are not being used to their full potential in collaborative activity (Mawer <i>et al.</i> 2010; Muñoz-Erickson <i>et al.</i> 2010)	Use AT to identify areas where information systems could play a greater role in facilitating collaboration
AT emphasises the importance of studying the context within which information systems are used, including the social context (Crawford and Hasan 2006; Kaptelinin and Nardi 2006)	Collaborative activities are inherently socio-technical systems (de Moor and Weigand 2007; Ritter <i>et al.</i> 2007)	Use AT to study how information systems complement/conflict with the roles that the people play or the rules that guide these people in the collaborative activity

Second, at the heart of activity theory is emphasis focuses on information sharing between people in a system, rather than focusing on individual information processing, as is the case in many IS studies (cf. Korpela *et al.* 2004; Kuutti 1991). The mediated approach adopted by activity theory is, therefore, useful in analysing how people share information with each other as they collaborate together. This is particularly pertinent as the employment of information systems shifts from information processing to information sharing and collaboration. Third, there is clear evidence that information systems are not being used to their full potential in collaborative activity (Mawer *et al.* 2010; Muñoz-Erickson *et al.* 2010). Because activity theory incorporates the study of both technological and non-technological tools in enabling collaborative activities (Kuutti 1991), this theory could be used by researchers to identify the limitations of information systems in supporting collaborative activities, or to uncover areas where information systems could augment or replace non-technological tools in such circumstances.

Fourth, activity theory emphasises the importance of studying the context within which technology is used, including the social context (Crawford and Hasan 2006; Kaptelinin and Nardi 2006). This makes activity theory particularly useful for analysing how information systems are used to share information between parties who are attempting to collaborate in a social setting. Crawford and Hasan (2006, p. 54) argue that *“complex phenomena associated with socio-technical systems...are prime targets for research using activity theory because activity theory provides a framework for emerging patterns of human activity in terms of changing purposes, awareness, focus of attention and tools”*. In conclusion, this paper has underlined the need for an improved scholarly understanding of how information systems support information sharing and collaboration within and across organizational boundaries. It has illustrated the suitability of activity theory as an evaluation methodology for further research in this area. Based on a number of key characteristics of activity theory, the paper highlights a number of areas which would benefit from the application of this theory. Activity theory provides a holistic and insightful conceptual vehicle which will allow researchers to investigate and evaluate how collaboration is achieved through all elements of IS (people, process, technology). It can also be employed to specifically examine how information systems support information sharing between people who are collaborating together. Used as an evaluation methodology, activity theory can be used by researchers to unearth the limitations of information systems in supporting collaborative activities and to identify areas where information systems could play an increased role in such contexts.

For example, the researcher is about to undertake a qualitative research project to study how collaborative decisions are made between General Practitioners (GPs) and patients with multiple chronic diseases on appropriate healthcare for the patient (see Figure 3). Because these decisions may involve trade-offs between guidelines/treatments for various diseases, patient preferences are relevant and decisions are thus collaboratively made between GPs and patients. The aim of the project is to use activity theory to identify, operationalise and evaluate how information systems could play a greater role in facilitating collaborative decisions in this specific context.

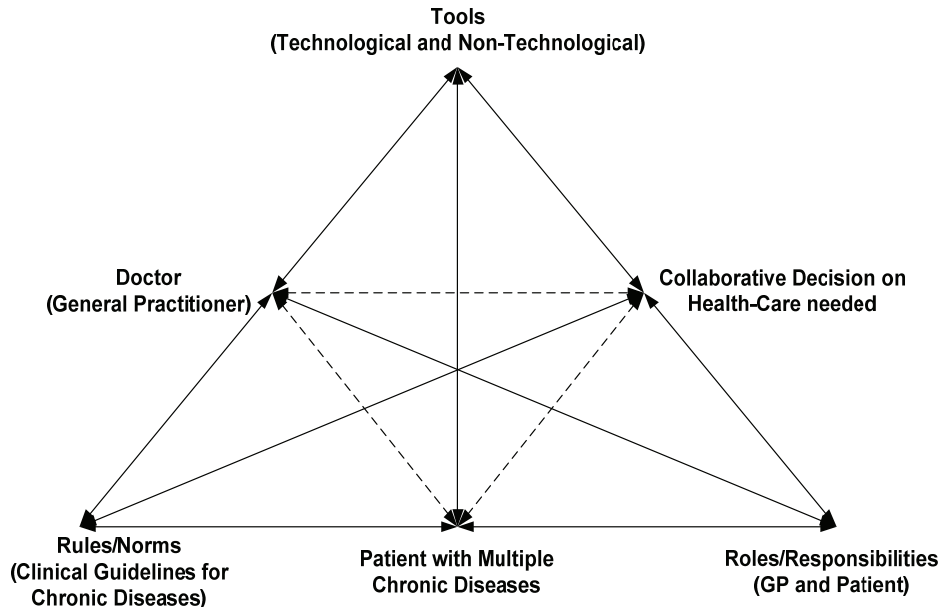


Figure 3: The doctor/patient activity system, adapted from Engeström (1987)

It is planned to first review the current activity system whereby GPs and patients collaborate to decide on appropriate medication; elective procedures; necessary lifestyle adjustments; etc. It is then proposed to design and develop a new pilot decision support system to aid information sharing and collaboration between the GP and the patient. The design of this system will be informed by reviewing how the collaborative decisions are currently mediated by tools (both technological and non-technological), the roles that GPs and patients play in making the collaborative decisions, as well as the rules that guide such collaborative decisions. Existing decision aids and paper-based rules/guidelines for individual chronic diseases will be coded into the new system. Any trade-offs/conflicts that exist between guidelines for different conditions will be highlighted by the new system.

A number of GPs will then be asked to use the pilot system and the transformed activity system (i.e. incorporating the new decision support system) will be analysed. Activity theory will be used to evaluate how the objective of the activity (the collaborative decision between the GP and the patient) is currently achieved through people, process and technology, versus how it is achieved with the introduction of the new decision support system. Drawing on activity theory, the researcher will investigate if the actors involved in the activity (the GP and the patient) acquire an improved understanding of the relevant clinical rules/guidelines that should guide collaborative decision in the case of multimorbidity. The researcher will also analyse if the introduction of the new system alters the roles that either party plays or alters the speed/nature of the collaborative decision that is reached.

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Audrey Grace

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Audrey Grace

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Dealing With Uncertainty Through KM: Cases in Four Software SMEs

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Abstract: In the current climate, preparing for change is an issue for companies large and small. For a Small to Medium Sized Enterprises (SMEs) where resources are significantly limited, it is imperative that efficient practices are in place to leverage the wealth of knowledge available both inside and outside the firm. It is vital that these organisations are swift and flexible enough to survive in this dynamic environment, this includes developing the ability to take stock of the sources and types of knowledge that are valuable to them and understanding how it is accessed and integrated into the firm's body of knowledge. Considering the economic turbulence, never has it been more important to focus on the knowledge capabilities of software SMEs, as it is on the back of these types of small high-tech organisations that innovation, growth and potential recovery will be achieved. Using a qualitative analysis approach in four Irish software SMEs, this study identifies sources of knowledge and occurrences of knowledge activities (KAs) as a means of understanding the firm's approach to knowledge management (KM) and how this may be leveraged therefore providing them with the flexibility to deal with environmental uncertainty.

Keywords: knowledge, knowledge management (KM), small and medium sized enterprises (SMEs), knowledge activity (KA) and software

1. Introduction

Defining data, information and knowledge as distinct and independent phenomena is an demanding endeavour. In particular it is noted that many authors use the terms information and knowledge interchangeably, those (Dennis, Earl, El Sawy, Huber) that considered organisational information processing in the 1970s, 1980s and early 1990s now focus their attentions on KM as an organisational strategy. Figure 1 represents data, information and knowledge as a continuum.

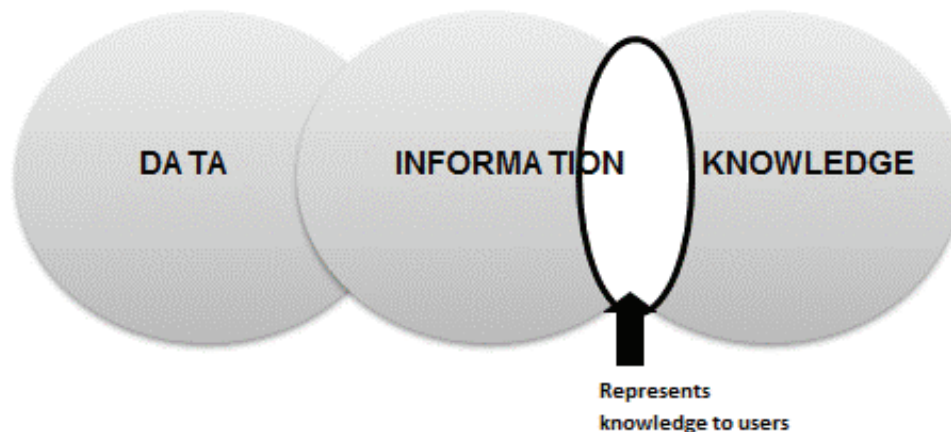


Figure 1: Knowledge continuum (after Davenport and Prusak, 1998; Wurman, 2001)

In Figure 1, it is evident that the extremes of each phenomenon are distinct however there is significant overlap between data/information and information/knowledge. According to Davenport and Prusak (1998, p147) *“the distinction between knowledge and information is seen as more of a continuum than a sharp dichotomy. Most projects that focus on internal knowledge [repository] deal with the middle of the continuum-information that represents knowledge to certain users”*. Alavi and Leidner (2001, p109) posit that *“information is converted to knowledge once it is processed in the minds of individuals”* while *“knowledge becomes information once it is articulated and presented in the form of text, graphics, words or other symbolic forms”*. The point where information becomes knowledge and vice versa is difficult to pinpoint with complete accuracy, however there is no doubt that these phenomena are closely linked. In order to adequately observe and measure knowledge in an organisation, it is essential that an operational definition is established. Supporting the view of Davenport and Prusak (1998) and the point indicated by the arrow in Figure 1, for this study knowledge occurs when –

Information represents valuable knowledge to a group focused on achieving a particular task

This definition is used to identify instances or occurrences of individual knowledge types. From a practical perspective, it is essential that an enterprise knows the type of knowledge that they need to focus on (Zhao *et al.*, 2012). Using the definition presented here, the aim of this study is to understand how software SMEs utilise their knowledge capabilities to achieve their organisational goals. It is important to state from the outset that factors such as leadership, culture, people, organisational structure, technology and business processes are fundamental to a successful KM approach (Hasanali, 2002; McDermott and O'Dell, 2001; Storey and Barnett, 2000; Sunassee and Sewry, 2002) however they were considered as part of a larger study and are not the core focus of this paper. This paper is structured as follows; the subsequent section briefly outlines the benefits in pursuing KM. Next a classification of knowledge activity is defined, the importance of leveraging KM to deal with environmental uncertainty is discussed and the research methodology is outlined. In addition, the background to each case is presented and the findings are considered. Finally, the authors consider the research findings and present the conclusions.

2. Harvesting the benefits of KM

Knowledge has become the source of competitive advantage and the source of organisational empowerment. Nonaka (1994) maintains that organisations must realise the importance of knowledge in order to survive in a highly competitive market place. He postulates that "*in an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge*" (Nonaka, 1994, p14). Stewart (1997) further argues that knowledge has become the most important factor in economic life. He acknowledges that knowledge is the chief ingredient in what organisations buy and sell, and the raw material with which organisations work. Intellectual capital, not natural resources, machinery or even financial capital, has become the one indispensable asset of corporations (Stewart, 1997). With due consideration, the capacity to incorporate and apply the specialised knowledge of organisational members is fundamental to a firm's ability to create and sustain competitive advantage (Drucker, 1993). This focus has forced organisations to re-think the way they manage their business since the emphasis is no longer on tangible assets but on people's abilities and experiences (Sunassee and Sewry, 2002). As a result organisations are identifying the strategies and technologies to manage this knowledge with the objective of gaining maximum benefits from an organisation's knowledge pool (O'Dell and Grayson, 1998; Sunassee and Sewry, 2002). However, organisational knowledge is of limited organisational value if the knowledge is not shared and managed (Alavi and Leidner, 1999). Alavi and Leidner (1999) maintain that KM has emerged as a new philosophy to control and support the flow of knowledge in an organisation. In addition, Bansler and Havn (2002) purport that KM contributes to improved organisational productivity, flexibility and innovation capabilities by enabling employees to share, integrate and reuse knowledge more effectively. Sunassee and Sewry (2002) further suggest that companies which have implemented KM solutions are better equipped to deal with business situations, as these companies have access to previous know-how. As a first step, the nature of organisational knowledge activities (KAs) is considered as a key components of KM.

3. Classification of knowledge activities

For the purpose of this research, a definition of KA proposed by Kraaijenbrink *et al.*, (2006, p23) is adopted as "*transactions or manipulations of knowledge where the knowledge is the object not the result*". It is evident that multiple researchers use different terms for the same/similar activity. Many of these definitions share common verbs such as storing, creating and applying knowledge in an organisational context. This research takes a balanced view of KAs, discounting the activities proposed by Leonard-Barton (1995), as they have a sole technical focus. This research summarises the terms widely used to describe KAs including *knowledge acquisition* (Alavi and Leidner, 2001; Huber, 1990; Holsapple and Joshi, 2004; Kraaijenbrink *et al.*, 2006), *codification* (Davenport and Prusak, 1998; Faran *et al.*, 2006; Kraaijenbrink *et al.*, 2006; Nevo *et al.*, 2007), *storage* (Alavi and Leidner, 2001; Huber, 1991), *maintenance* (Conway and Sligar, 2002; Holsapple and Singh, 2004; Holsapple and Whinston, 1996), *transfer* (Alavi and Leidner, 2001; Huber, 1990; Nonaka and Takeuchi, 1995) and *creation* (Davenport and Prusak, 1998; Kayworth and Leidner, 2004; Nonaka and Takeuchi, 1995; Pentland, 1995).

4. Developing knowledge capabilities to deal with uncertainty

Organisations are cognitive in nature; as a result they learn and develop knowledge (Argyris and Schön, 1978). Hedberg (1981) defines organisational learning as a two pronged process, the first where organisations adjust themselves to deal with reality and the second where they effectively leverage knowledge to improve their fit with the external environment. In order to achieve this *“the organisation must have mechanisms to learn about and interpret external events”* (Daft and Lengel, 1986, p566). In order to maintain and develop organisational memory it is essential that an organisation learn from both its internal context and external environment (Bennet and Bennet, 2004).

“Organisations have no other brains and senses than those of their members” (Hedberg, 1981, p6). Considering this perspective, an organisation as an entity is completely reliant on the quality and expertise of the sum of its employees. However, Argyris and Schön (1978) suggest that organisations often know less than the sum of their members. This may be due to communication issues e.g. information filtering, distortion and channel overload (Argyris and Schön, 1978). The lack of a formal learning/knowledge repository can contribute to this. Huber (1989) points out that if knowledge is not formally stored, it may be lost on three counts, firstly through staff turnover, secondly through an organisation not knowing what to store based on future needs and finally through an inability to share knowledge. One example of the benefits that may be derived from maintaining a knowledge repository is Chrysler automobile company. They used an *“Engineering Books of Knowledge”* to store an *“electronic memory”* of engineer’s past experiences (Davenport and Prusak, 1998). This repository was actively leveraged to inform engineer decision making in future development projects.

In terms of problem solving, organisations build an advantage in boom times however, slack reduction acts as an environmental indicator of crisis which can activate problem solving mechanisms, and this in turn can lead to organisational learning (Hedberg, 1981). In addition, Pounds (1969) considers management learning through ‘problem finding’. Where Hedberg (1981) presents slack as a trigger, Pounds (1969) suggests that problems can be triggered through discrepancies in historical models. These models act as an archive of past experience to estimate the short term future, though Pounds (1969) admits in some cases that these models were carried in the heads of management supported by routine reports. However, opportunity triggers are less evident as problem triggers are more common (Hedberg, 1981). Yet, organisations may identify new opportunities in the market, which in turn, facilitate learning. Together KM, organisational learning and memory influence how organisations deal with knowledge and its impact on organisational effectiveness (Jennex and Olfman, 2002).

5. Research approach

This study pursued a qualitative analytical approach (Ågerfalk and Fitzgerald, 2008) using multiple case studies, each case was selected using purposeful sampling (Patton, 1990). The cases were selected based on their size and industry sector. The software industry *“is a knowledge industry. Its major product is knowledge itself and its major output is research which translates into new products and services”* (p562) (Bernroider, 2002) Software development may be characterised as knowledge work (Schönstrom and Carlsson, 2003). As the objective of this study was to explore the knowledge approach leveraged by small software development firms, the focus of the study was on the two core business processes of sales and software development. Based on a selection strategy, positional methods were used to uncover sales and technical managers while other respondents were selected based on reputation (Knoke, 1994). Twenty two individuals were interviewed; each interview was approximately one hour in duration. Interviews were taped and transcribed. The exploratory nature of the study coupled with the *“thick transcripts”* (p56) (Miles and Huberman, 1994) meant that qualitative analysis could be conducted through the use of coding techniques (Miles and Huberman, 1994). The classification of KAs was used for the purpose of data analysis in this study. Each KA was assigned a code and this code was utilised to classify the nature of KAs, these categories were then assigned chunks of data derived from the interview transcripts. Each transcript was analysed using the KA codes and a memo was generated at the level of the interview.

6. Findings

6.1 Background to cases

<p>Case 1: HelpRead Ltd. produces assistive software to support learning disabilities. The complexity of the software product offering means that a deep understanding of customer requirements is essential to build a useful product. The complex customer requirements coupled with innovative management initiatives, such as brainstorming, provided rich insights from a KM perspective.</p>
<p>Case 2: TravelSoft Ltd. was established in the early 1990s. Their core offering at that time was to provide travel software to one main customer, who was also the company's main shareholder. In 2004, TravelSoft Ltd. took greater financial control of the organisation; while continuing to provide software to their former parent organisation. Change processes such as hiring new managers, pursuing product development and attracting 'third party customer' offered significant opportunities to study KM.</p>
<p>Case 3: Software Solutions Ltd develops software solutions in the client server market. Software consulting companies have been known to pursue formalised approaches to KM (Hansen <i>et al.</i>, 1999), in Software Solutions Ltd. this is not the case. While significant KA was required to support the divisions independently, as well as the transfer activity across divisions, much knowledge activity was informal and ad-hoc in nature, primarily driven by focused sales activity.</p>
<p>Case 4: Doc Man Ltd. is a small satellite operation for an edocument management software developer based in Givisiez, Switzerland. From a KM perspective, the size, location and functional specialization of the site presented unique characteristics for consideration.</p>

6.2 KM approach at HelpRead Ltd

HelpRead was focused on building a collective organisational memory that facilitates continued growth through the introduction of new hires and new products. This is particularly important to them in terms of acquiring external knowledge to inform new product development. Table 1 identifies 82 *instance of KA* at HelpRead; the majority of activities presented themselves through knowledge acquisition, storage and transfer.

Table 1: Distribution of KAs at HelpRead Ltd

KA /Company	No. of KAs (%) / Knowledge Focus by Activity
Acquire	17 (21%) 53% Product Knowledge (9 of n=17 activities)
Codify	11 (13%) 90% SW Dev, Project and Product Knowledge (10 of n=11 activities)
Store	24 (29%) 71% SW Dev, Product, Project Knowledge (17 of n=24 activities)
Maintain	8 (10%) 63% Project and SW Dev Knowledge (5 of n=8 activities)
Transfer	17 (21%) 83% Product, Project and SW Dev Knowledge (14 of n=17 activities)
Create	5 (6%) 80% Product Knowledge (4 of n=5 activities)
Total	82

The study identified 82 KAs; 113 instances of knowledge types were uncovered. The difference in these figures can be explained by single KAs leveraging multiple knowledge types in some instances, thus increasing the instances of knowledge types identified in the analytic memos. It is also important to note that, at the time, HelpRead Ltd. was not in a new product development phase. Using Table 3, the difference in intensity between these types of activities is indicative of HelpRead's position as a growing organisation. Knowledge acquisition intensity at 21 percent (n=82) showed that fifty three

percent of all knowledge acquisition activity was focused on gathering product knowledge supporting Groen's (2006, p124) view that in high-technology SMEs require knowledge from external sources to support new product development.

At 13 percent (n=82) codification activity was relatively low intensity, this was reflective of the uncertainty around what the company needs to know in the future. This is predominantly evident with the Technical FAQ, which lacked buy-in from the entire development team. The Development Manager admitted that as a team *"they didn't know what they should know"*. Most codification activity was directly related to refining the discussions at group meetings into documents which are made available over the Intranet. Over 90 percent (n=11) of all codification activity identified in Table 1 was related to product development knowledge. Codification was largely not a sales related activity. The well-defined scope of the *Goldmine™* sales system meant that no KA was required to support the refinement and distillation of sales related knowledge. In addition, the experience of the sales team meant they know what important customer and sales related knowledge should be stored for future use.

The high occurrence of storage activities at 29 percent was indicative of the importance placed on storing knowledge in the new Intranet-based quality system - approx 74 percent (17 of n=24 storage activities) of storage activity involved the Intranet. These activities primarily included storing software project documents and employee skills documents, in line with the compliance requirements outlined by IS9001:2000. The codification intensity also included the level of customer information captured and stored by the sales team. This 29 percent reflected the move to store the knowledge gathered from acquisition, codification and transfer activities. Maintenance activities at 10 percent highlighted the company's focus on maintaining software and product development knowledge. Surprisingly, transfer activity was high intensity at 19 percent - with closer inspection; the role of the Technical Director was integral to this. At 6 percent, knowledge creation was very low. While Table 1 shows that 80 percent of knowledge creation activity was focused on product knowledge, in line with company strategy, the lack of other types of knowledge creation may be explained by the pressures associated with the recent rapid growth in employee headcount and the increased product portfolio.

6.3 KM approach at TravelSoft Ltd

At the time of interview a new Application Solutions Manager had been in place at TravelSoft for approximately eight months. From a Telecoms background, he implemented a number of organisational strategies to develop embedded processes and most importantly to bring a new product to the travel software marketplace. It is primarily these management initiatives that contributed to the high number of KAs, 147 instances presented in Table 2.

Table 2: KAs at TravelSoft Ltd

KA	No. of KAs (%)/Knowledge Focus by Activity
Acquire	16 (11%) 44% SW Dev Knowledge (7 of n=16 activities) 25% Travel Industry knowledge (4 of n=16 activities)
Codify	30 (20%) 36% SW Dev (11 of n=31 activities) 32% Process/Product Knowledge (10 of n=31 activities)
Store	31 (21%) 41% SW Dev and Project Knowledge (12 of n=29 activities) 41% Process/Product Knowledge (12 of n=29 activities)
Maintain	20 (14%) 40% SW Dev and Project Knowledge (8 of n=20 activities) 40% Process/Product Knowledge (8 of n=20 activities)
Transfer	41 (28%) 68% SW Dev and Project Knowledge (28 of n=41 activities)
Create	9 (6%) 56% Product Knowledge (5 of n=9 activities)
Total	147

The KAs identified used more than one type of knowledge during a single KA, consequently providing the rationale for the 211 instances of knowledge types identified for TravelSoft. The knowledge focus

at TravelSoft was quite consistent and reflected the company's strategic objectives. The emphasis on software development, project, process and product knowledge was marked. Knowledge of the travel industry made up a quarter of the knowledge acquisition activity.

At HelpRead Ltd. 82 instances of KAs were observed, KA at TravelSoft was considerably higher at 147 instances. This intensity may be explained by a number of factors. Knowledge acquisition activity at 11 percent (16 of n=147) was due to the acquisition of consultant knowledge on new product development, employee training, relevant books, journals and travel conferences. In terms of codification at 20 percent activity, project related knowledge was refined and stored. At 21 percent activity, storage activity was almost in line with the volume of codification activity. This shows that TravelSoft were good at following through on this type of activity. For example the steering committee refine and store the new Adept framework templates in the relevant artefacts. R&D acquisition, codification, storage and maintenance of knowledge contribute to the dense volumes of KA. Activities such as Internet research in the travel area added to the level of knowledge acquisition activities, while refining and storing this knowledge contributed to the volume of codification and storage activity. At 14 percent, maintenance activity was lower than knowledge codification and storage activity. This could be owing to the fact that some of the knowledge stored did not require updating, for example conference and journal papers on the travel industry will not be changed although new papers may be added over time resulting in increased storage activity.

Knowledge transfer at 28 percent (41 where n=147) represented the highest volume of KA. Leveraging a variety of routine and non-routine modes (these are outlined in next section). This organisation encouraged knowledge transfer at all levels of the organisation. Knowledge creation was much lower at 9 instances (6 percent where n=147). These activities were all generated around new product and process development placing these initiatives at the core of all KAs of TravelSoft at that time. Table 2 shows a spread of 66 percent of KA at TravelSoft across knowledge acquisition, codification, storage and maintenance activity, while transfer and creation activity account for 34 percent of all KA. By comparison, the distribution at HelpRead for the same activities was 73 percent and 27 percent respectively. This shows that through their change process, TravelSoft were good at leveraging the more 'valuable' types of KA.

6.4 KM approach at Systems Solutions Ltd

KA at Systems Solutions was mostly characterised by its informal nature. The Managing Director admitted that when he is involved with requirements analysis for the business intelligence division the knowledge is documented and stored in an A4 pad. One Project Manager from the Application Division admitted that it was not uncommon to calculate a project price on the back of a piece of paper in the car park before attending a meeting with a prospective customer. Table 3 illustrates a total of 105 KAs identified.

Table 3: KAs at Systems Solutions

KA	No of KA (%) /Knowledge Focus by Activity
Acquire	16 (15%) 44% Product Knowledge (7 of n=16 activities) 31% Customer Knowledge (5 of n=16 activities)
Codify	14(13%) 86% Sw Dev and Project Knowledge (12 of n=14 activities)
Store	27(26%) 67% Sw Dev and Project Knowledge (18 of n=27)
Maintain	13 (12%) 38 % Sales Knowledge (5 of n=13 activities) 23% Project Knowledge (3 of n=13 activities)
Transfer	30(29%) 60 % Sw Dev and Project Knowledge (18 of n=30 activities)
Create	5 (5%) 80 % Project Knowledge (4 of n=5 activities)
Total	105

One hundred and thirty one instances of knowledge type were identified across the KAs; this indicates that some KAs leveraged multiple knowledge types. It is apparent that knowledge acquisition and maintenance were exceptions in terms of their knowledge focus. Knowledge acquisition was focused

on product and customer knowledge, these knowledge types were largely relevant to the Business Service Management and SAP Solutions divisions focused on software resale. Knowledge maintenance activity was focused on sales knowledge at 38 percent. The emphasis on sales primarily reflects the knowledge requirements of these two divisions. From Table 3, the other KAs were focused on software development and project knowledge serving the knowledge needs of the Business Intelligence (data warehousing) and Application Development divisions.

Project related knowledge was codified, stored and maintained in order to meet the requirements of pharmaceutical customers who must abide by Food and Drugs Authority (FDA) regulations. From Table 3, it is evident that at 26 percent, storage activity was higher than both codification and maintenance activity together at 21 percent. This may mean that Systems Solutions store large volumes of documentation without refining and formatting it, and in the longer term, without updating it. As a result, it seemed that they hold large these volumes for the sole purpose of protecting themselves from external threats such as possible audits. At 15 percent, knowledge acquisition appeared important, however more than half of this activity is attributed to sales and customer interaction.

At 5 percent, knowledge creation activity was very low. The Managing Director was the main source of the knowledge creation activity at Systems Solutions. It seems that the time pressures associated with meeting project deadlines meant that there was little time for knowledge creation activity amongst the divisions. In the case of Systems Solutions knowledge creation was not the responsibility of those at an operational level.

Knowledge acquisition, codification, storage and maintenance account for 66 percent of all KAs while knowledge transfer and creation amount to 34 percent. This was consistent with TravelSoft though it differed in the case of HelpRead whose focus on knowledge storage activity through the new company Intranet tips the balance of KA distribution towards the earlier activities.

6.5 KM approach at DocMan (Ireland) Ltd

At DocMan (Ireland) the total volume of KA was low in comparison to the other cases considered. This may be endorsed by the nature of the well-defined work on software development components at the DocMan site in Ireland. The operations at the Irish site are part of a larger document management software component and the output from DocMan (Ireland) was integrated by the software integrator at the Swiss headquarters. As a result of this task specificity, there was a set of core KAs from which there was minimal diversification at the Irish site. The breakdown of KAs for DocMan (Ireland) Ltd. is presented in Table 4.

Table 4: KAs at DocMan (Ireland) Ltd

KA	No. of KA (%) / Knowledge Focus by Activity
Acquire	7 (12%) 57% SW Dev Knowledge (4 of n=7 activities) 43% Customer Knowledge (3 of n=7 activities)
Codify	11 (18%) 64% SW Dev and Project Knowledge (7 of n=11 activities)
Store	9 (15%) 67% SW Dev and Project Knowledge (6 of n=9 activities)
Maintain	7 (12%) 57% SW Dev and Project Knowledge (4 of n=7 activities)
Transfer	24 (40%) 79% SW Dev and Project Knowledge (19 of n=24 activities)
Create	2 (3%) 100% SW Dev and Project Knowledge (2 of n=2 activities)
Total	60

Table 4 illustrates a significant level of knowledge consistency across all of the KAs. Software development and project knowledge represented at least 57 percent of the knowledge focus for all six KAs. This uniformity across activities also supports the task specialisation activity at the DocMan (Ireland) site.

DocMan (Ireland) leveraged some external knowledge resources at 12 percent (7 where n=60) knowledge acquisition, however the main source of knowledge is the headquarters in Switzerland and this was achieved through knowledge transfer activity which was very high at 40 percent (24 where

n=60) of total activity. It is from here that the majority of customer requirements were received as well as any new product knowledge.

Knowledge creation activity was very low at 3 percent (2 where n=60). This may be the result of the location of this development team with most new ideas being generated at a higher level at company headquarters.

Although the total volume of KA was low, the split between the acquire, codify, store and maintain KA at 57 percent and the knowledge transfer and creation activity at 43 percent is more evenly balanced than that observed at HelpRead Ltd., at 73 percent to 27 percent respectively. The geographic location, the task specialisation and the maturity of the parent organisation may be attributed to the knowledge transfer capabilities identified at DocMan Ireland.

7. Discussion

The previous section explores the distribution of KAs across four software SMEs. As part of this consideration, it is imperative to take a closer look at the firm’s motivation for pursuing different KAs in terms of their wider organisational objectives. This is even more crucial in the case of an SME where their ability to leverage the resources available to be them, enabling them to be flexible enough to pursue alternative organisational goals is essential, as they are more susceptible to external forces. Table 5 provides a sample of the organisational goals pursued by the SMEs. Each goal is characterised by the knowledge types and KAs used to achieve the objectives of the firm at a particular time.

Table 5: Achieving organisational goals through knowledge activity

Company	Knowledge Focus	Organisational Goal	Knowledge Activity
HelpRead	Software Development Product Project Customer	<ul style="list-style-type: none"> • New Feature Development • New Product Development • Meet Customer Needs • Industry Accreditation 	<ul style="list-style-type: none"> • Transfer and Creation • Acquisition, Transfer and Creation • Acquisition • Codification and Storage
TravelSoft	Software Development Project, Product, Process, Travel Industry	<ul style="list-style-type: none"> • New Product Development • Establish a customer base • New Business Process Development 	<ul style="list-style-type: none"> • Acquisition, Transfer and Creation • Acquisition • Codification, Storage and Maintenance
Systems Solution	Project, Sales, Customer, Software Development	<ul style="list-style-type: none"> • Compliance • Attract new customers 	<ul style="list-style-type: none"> • Storage • Acquisition
DocMan (Ireland)	Software Development, Project, Customer	Serve the needs of the parent organisation	Transfer

Table 5 highlights that the KM approaches differ across organisations; this is typically due to the difference in culture, organisational structure and organisational objectives therefore organisations need to identify a unique strategy that suits their needs. Hansen *et al.* (1999, p109) state that, “a company’s knowledge management strategy should reflect its competitive strategy” and this is widely reinforced in extant literature (Davenport and Prusak, 1998; Hasanali, 2002; Sunassee and Sewry, 2002). Aligning KM strategy to the business strategy seeks to clarify what the company must know to in order to realise what the company can do. It is well supported that organisations, which did not develop a separate KM strategy, ended up with their KM initiative losing focus, priority and impact (Chourides *et al.*, 2003). Considering the lens (KAs) used in this study to characterise the firms KM approach, Figure 2 below provides a holistic view of the key components examined, these include knowledge type, KAs, the underlying organisational strategy and the benefits derived from the KM approach. Figure 2. illustrates a diagnostic instrument which could provide SMEs with the capability of tangibly measuring their current KM approach.

Ideally, in times of uncertainty the firm should be flexible enough to leverage knowledge capabilities in order to pursue the goals of the organisation at that time. This formalised systematic approach may result in the establishment of knowledge rules which can be followed enabling the firm to develop embedded KAs. By doing this, the organisation can learn from past experience to inform future development.

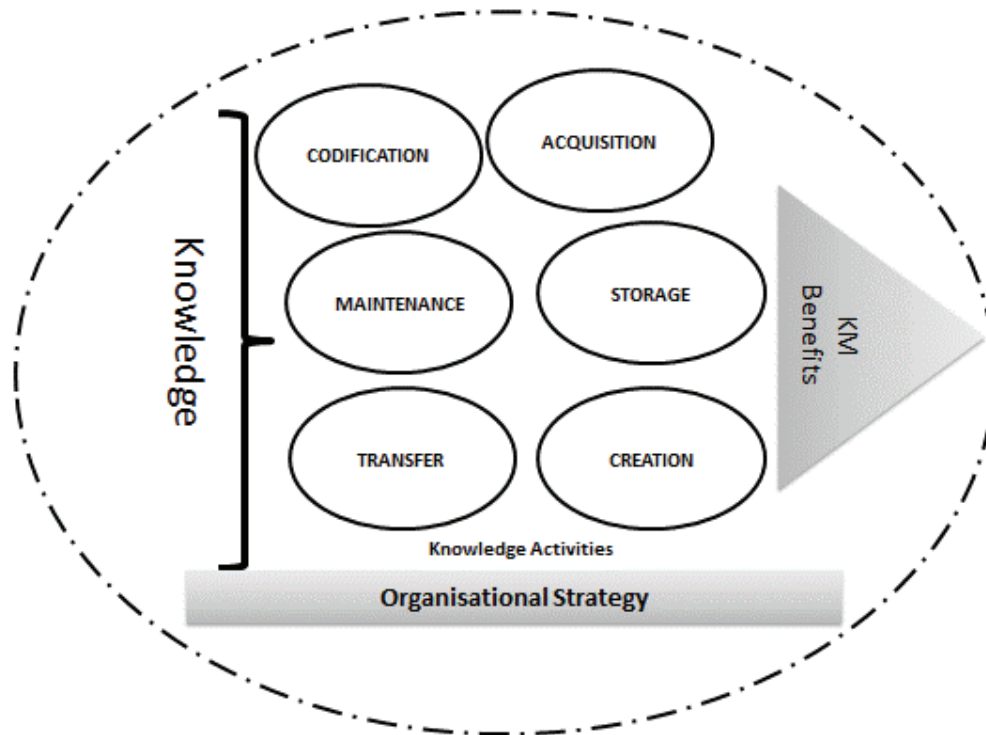


Figure 2: An overview of the KM approach

8. Conclusion

KM may be achieved if it is closely aligned with the strategic needs of the organization. This approach seeks to identify the organization's requirements and evaluate a knowledge strategy based on the business's strategic vision. In a software development company, one organisational objective may be to improve the efficiency of the software developers as a means of increasing profits on individual projects. As a result an organisation's knowledge strategy may be to 'avoid reinventing the wheel' leveraging existing programming code in new projects. Ideally the appropriate knowledge capabilities should be in place to respond to the changing objectives of the firm or even support multiple goals e.g. to support new product development activity and a focused sales strategy to improve customer relationship management. SMEs need to give formal consideration to their KM approach, in order to manipulate knowledge in a way that serves their specific decision making needs at a particular time.

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Analyzing Lessons Learned to Identify Potential Risks in new Product Development Projects

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Abstract: The paper presents a methodological implementation of the synergetic relation between past and future by utilizing analysis of past occurrences to mitigate future possible risks. When an organization undertakes the development of a new product, it should prepare a risk management plan that can outline the guidelines to mitigate possible uncertainties with a negative impact on the development project or the expected product. This process can be performed by analyzing the information accumulated during previous projects executed by the organization during the processes of developing other deliverables. The method of transforming organizational information into applicable risk management guidelines is based on two research techniques: content analysis and cluster analysis. The content analysis approach requires a deep understanding of the lessons learned dataset collected from past projects while documenting undesired events or failures. This process integrates qualitative and quantitative procedures including a review of each record, a classification of relevant hazardous factors, and a computation of recurring factors in completed projects and processes. The cluster analysis approach uses the risk dataset to create a risk tree that represents relative weights for each risk factor, while considering the reoccurrence of similar events in similar circumstances. Implementation of the methodology in order to identify potential risks, in particular analyzing lessons learned in technological organizations, yielded interesting organizational risk tree that shows a substantial weight accumulation in the areas of miscommunications and misunderstanding of stakeholder responsibilities. The results emphasized the following susceptible items: responsibility definition, delivery method, communication and information needs and responsibilities, and change management. The findings exposed the 'soft skills' of project managers and project teams, rather than technical issues or engineering problems, as being the vulnerable areas that should be managed carefully in order to finish the project successfully. The study offers a generic validated methodology for risk identification based on analysis of lessons learned, supported by results of an implementation of the methodology in a high-tech company. The method of analysis can be applied by managers of new product development projects to identify risk issues, classify them into groups, and construct a risk tree that represents the project risk areas and their relative weights.

Keywords: risk management; lessons learned; project management; clustering; content analysis

1. Introduction

Every organization aims to get a competitive advantage over the other organizations playing in the same arena. Especially today, when the business battle field is usually global, very dynamic and is subject to countless changes, any opportunity to be better prepared for the future creates an advantage. Therefore, a more accurate and relevant risk management plan will give any organization this required advantage over its competitors. The current research was targeted to provide a better and innovative method to set up risk management plans based on a systematic methodology constructed of an array of consecutive sequential steps. The development of the methodology is based on two assumptions: (1) Modern organizations manage portfolio of projects. Many of the organizations nowadays are operating through a continuous implementation of projects. Although every project is a different endeavor, organizations are constantly moving towards achieving their vision by managing a portfolio of projects. Since all, or at least most, of the organizational past projects were performed within a similar environment, and usually managed and at least partially carried out by the same teams, it is worthwhile to embrace a broad approach that takes into account not only the individual project but rather the organizational project portfolio (Kerzner, 2005). (2) Every organization's archive contains huge volume of historical valuable information. Almost every modern organization possesses an archive that contains a huge amount of information that can be transposed into valuable management knowledge. Modern communication technologies enable people and organizations to create, distribute, receive and store large quantities of data. There are number of tools and techniques that an organization might use in order to transform its data into information, and further into knowledge. Since the organization already has this information, no additional efforts are required for its production (Lipshitz, Popper and Friedman, 2008; Hill, 2008).

Based on these two concepts, the research was targeted to develop a structured methodology for project oriented organizations to design the guidelines for a risk management plan based on an

analysis of documents that already exist in the organization. Therefore, the research objectives were defined as follows:

- To develop a generic methodology that can identify organizational future risks based on documented organizational known history. The methodology focuses on representing the transposition of existing information, available in the form of documents or electronic records, either structured or unstructured, into valuable managerial knowledge, for the purpose of identifying prospective events, actions or occurrences.
- To demonstrate the generic methodology by formulating a Risk Breakdown Structure (RBS) from lessons learned documents. The study was targeted to generate a specific risk management tool – an RBS, which is an organizational risk hierarchy, from a specific type of documents, i.e., lessons learned documents.

The paper starts with a review of risk management tools and techniques, especially those based on documentation analysis methods, followed by a brief description of the developed methodology to transform lessons learned into outputs of a risk management plan. Then, a case study in an Israeli high-tech company is presented. The detailed analysis is presented with a list of identified risks, categorized by subjects and interrelations. Final comments summarize the results and the contribution of the current research to the academic and professional communities.

2. Risk management tools and techniques

Cohen and Palmer (2004) define risk as “the potential for complications and problems with respect to the completion of a task and the achievement of a goal” (p.11). Other definitions emphasize the perception of risks as uncertainties. Thus, suggest a broader interpretation of the term “risk” as management of opportunities, i.e., positive occurrences, rather than only management of potential negative risks (e.g., Ward and Chapman, 2003; Garrett, 2005; Olsson, 2007).

2.1 Risk management methodology

The Guide to Project Management Body Of Knowledge (PMBOK® Guide), published by the Project Management Institute (PMI, 2008), describes the knowledge area of project risk management as the processes that address risk management planning, identification, analysis, response, and monitoring and control. Project risk management processes are targeted to increase the probability and impact of events that are expected to positively affect the project as well as to decrease the probability and impact of events that are expected to negatively affect the project or the achievement of its objectives. Effective implementation of a risk management methodology and practice positively affects the success rate of any project or process. The relationship between risk management and project success has been described by various researchers investigating different industries (e.g., Raz, Shenhar and Dvir, 2002; Cook, 2005; Nalewaik, 2005; Marx and Link, 2002). The risk management methodology presented by the PMBOK Guide (PMI, 2008) starts with risk identification, proceeds through risk qualitative and quantitative assessment, followed by planning risk response, and ends with a continuous process of risk monitoring and control. Similar methodology is presented by the SEI (Software Engineering Institute) (Higuera and Haines, 1996) and by the ERM (Enterprise Risk Management) framework, developed by the Committee of Sponsoring Organizations of the Treadway Commission (COSO, 2004). The PMBOK® Guide methodology can be described by the following chart.

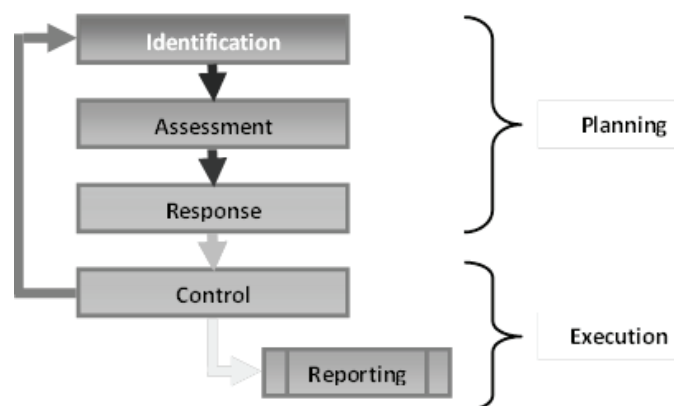


Figure 1: Risk management methodology by the PMBOK guide

The risk identification process detects prospective events which might affect the project and documents their characteristics. Risk assessment deals with evaluating two fundamental parameters with regard to each identified risk event: the probability of occurrence and the impact of the identified risk events. The risk evaluation might be either qualitative or quantitative, and it is used to grade each of the identified risk events in order to prioritize them. Risk response planning involves the development of optional actions targeted to increase opportunities and to reduce threats to project activities. There are various strategies that can be implemented, including avoid, transfer, reduce, or accept threat risks and exploit, share, enhance, or accept opportunity risks. The risk control process tracks identified risks, monitors residual risks, identifies new risks and executes risk response plans. Risk management outputs should be updated and communicated to relevant stakeholders throughout the project lifecycle.

The initiating and probably the most important phase of risk management is risk identification. This phase involves the detection and classification of all known, and as much as possible also unknown, risks, thus producing the foundation on which the whole risk management process can be established (Chapman, 2001). Therefore, the current study focuses on tools to enhance.

2.2 History-based methods for risk identification

Organizational information and knowledge, which is a product of historical occurrences, provides a wide basis for analysis of future possible events. Historical information analysis techniques are derived either from investigation of experiences that happened to employees and managers, or from the investigation of documents that were produced continuously by various stakeholders recording different activities. History-based methods include checklists, interviews, and documentation reviews.

A *Checklist* is an easy-to-use and effective aid which represents a list of possible risks, based on historical information and accumulated organizational knowledge. A generic checklist may be generated from published research such as Caper Jones's software risks, Rex Black's quality risks, or Barry Boehm's top ten risk list (Ravindranath, 2007). Alternatively, the checklist can be provided by an established professional association such as the Software Engineering Institute (SEI, 2005), the National Institute of Standards and Technology (NIST, 2002), or other professional institutes in the industry. A specific checklist might be produced by an organization, thus capturing particular risks that previous projects within the organization have been exposed to (Hillson, 2004).

Interviews are conducted in order to capture existing knowledge by talking to people. Project team members and managers, experienced project participants, project stakeholders and professional experts are interviewed to produce a comprehensive list of risks (Zsidisin, Panelli, and Upton 2000).

Documentation Reviews include a set of techniques by which organizational and project documentation related to various types of activities is reviewed to analyze historical events for better future management. Typical documents for review are lessons learned files or debriefing registers, which record past experiences and can be used to enrich organizational knowledge (Kerzner, 1999; Williams, 2003).

The current study is based on the concept that there is a synergetic linkage between the past and the future. In order to be better prepared for future experiences we need to understand past occurrences. The research methodology relies upon a history-based documentation, which is analyzed and investigated in an ordered way to infer knowledgeable potential risks.

3. The research methodology for analyzing lessons learned to identify potential risks

The research methodology is based on two research techniques: content analysis and cluster analysis.

The first two steps include qualitative and quantitative content analysis (Krippendorff, 2004; Neuendorf, 2002). Qualitative content analysis is a process of understanding, interpreting, analyzing and coding of documents. In the current study, this process was performed using the Atlas.ti software package on an especially developed codebook constructed of items from the project management body of knowledge (PMI, 2008) with additional items related to business process flow (Jeston and Nelis, 2006). The qualitative analysis requires reading each document, understanding it in the context it was written, and categorizing by subjects or concepts. In the current study, the text units for analysis were the collected

lessons-learned documents. The coding process was conducted using a specially-developed codebook that contained 200 codes derived from the current body of knowledge in project management. Quantitative content analysis is based on the same text units, though requires statistical analysis. It contains word and phrases crunching, and descriptive frequency analyses assigned to investigate the occurrences of codes, groups of codes and words. The quantitative analysis results present numerical examinations of the interpreted text units and the related categorized codes, such as word count, code frequency analysis, and other categories frequency analyses. The output of these two analyses is a structured dataset of all the risks that were identified in previous lessons learned as gathered from an array of historical projects performed and managed by the organization.

The following phase is clustering. Cluster analysis is performed in this research by a supervised classification of patterns derived from the qualitative and quantitative content analyses (Jain, Murty and Flynn, 1999). The clustering techniques were investigated and the Ward's method, using the Dice distance similarity measure, was found as the most appropriate one for this purpose. Clustering is an advanced statistical method targeted to represent data, based on measures of proximity between elements, expressed by maximum distances between groups and minimal distances within each group. Joining or tree clustering algorithms, which were used in this study, are designed to join objects into sequentially larger groups based on some measure of similarity or distance. The distances represent a set of rules that function as criteria for grouping or separating objects, and they can be composed of one or more sets of rules or conditions. The output of this analysis was a hierarchical RBS (Risk Breakdown Structure) that represents the project and organizational risks, arranged in hierarchical order where every set of risk events are grouped under a common risk factor.

An RBS (Risk Breakdown Structure) is defined by David Hillson (2002) as: "A source-oriented grouping of risks that organizes and defines the total risk exposure of the project or business. Each descending level represents an increasingly detailed definition of sources of risk". The RBS is a hierarchical structure of risk factors and events.

The following chart represents the research methodology steps.

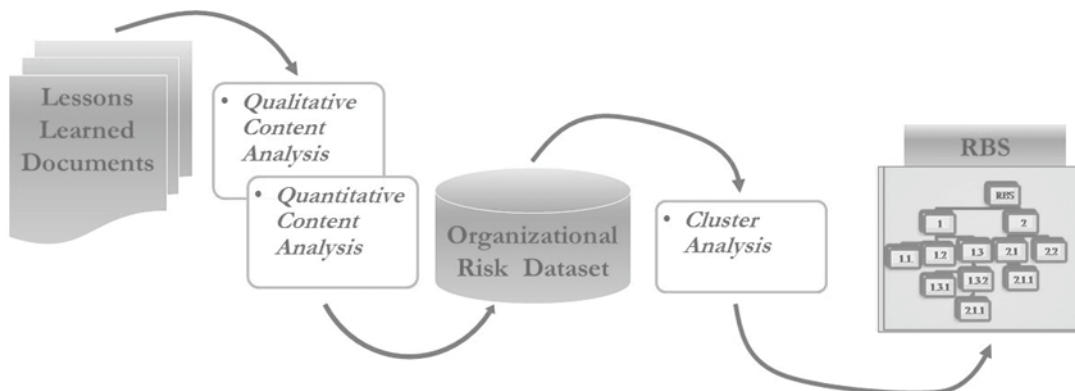


Figure 2: The research methodology

4. Case study: An IT company

The research methodology was implemented in a High-Tech company in Israel. The company is an IT service provider, which is specializing in end-to-end solutions in all market sectors. The company is a top Israeli IT provider. It is a public company trading on the Tel Aviv Stock Exchange and employs over 2,500 experts. Its services include outsourcing, software development, ERP system applications, payroll and human resource solutions, technical support and helpdesk, etc. The company provided an access to its lessons learned documents which were accumulated during 12 months.

4.1 Qualitative content analysis

In order to demonstrate the qualitative content analysis process, a representative lesson learned document, which is one of the 40 lessons learned documents of the IT Company that was analyzed in the research, is presented.

Introduction: The project was designed to analyze and implement the central system software upgrading procedure of a very busy mainframe that supplied online services to a large array of users.

Vered Holzmann

The project was postponed several times due to customer reluctance to permit service technicians to perform any alteration on the brittle state of the original settings of its system software. The project was very sensitive since no updates to the original installation were ever performed. Thus, implementation required an extremely well designed plan, exceptionally skilled professionals and a very thorough testing program. In addition, the total project set on the critical path, thus there was a need for a stringent risk mitigation plan based on a wide identification of risk events followed by a progressive occurrence forecast.

Story: A qualified team of technicians simulated, as close as possible, the actual resident environment at the customer's labs. A complete array of tests was performed. A detailed log of every occurrence was maintained. Problems of any nature were discussed first within the local division and further clarified with the vendor's global technical department. Finally the personal matrix of responsibility was assign and tested. The preparations for the event were perfect, and then everything that could go wrong actually did go wrong. The execution was postponed several times, only hours before due date, after everything was already put in place. Hence various personnel shifts were necessary, which demoralized the team and seriously shook the planned subordination structure. At last the upgrading started. Soon uncharted bugs appeared and hampered system performance. After consultation the team manager decided they could fix the modules, and proceeded with the upgrade. However immediately after passing the point of no return, namely, the point where the old system could no longer be reinstated it became evident that the new upgraded one did not work properly. The customer was informed, and then everybody involved became panic-stricken. The vendor contacted all his global users and asked them to participate in an international temporary consortium to solve the current problem. At the eleventh hour of the project's maximum expected duration, following intense global communications, a software engineer, located in India, came up with the answers and the upgrade went through.

Coding: The following codes were assigned.

Table 1: A sample of a code assignment to a lessons learned document

Code	Name
1090	define process procedures
1110	define stakeholders involvement
1120	define stakeholders expectations
1150	define critical success factors
1170	involve customer in process method definition
1180	involve customer in deliverables definition
1190	involve customer in success criteria definition
1200	involve customer in process limitations definition
1230	define product attributes
1240	define delivery method
1290	define work constraints
1330	define required documentation
1360	define wp (work package) prerequisites
1430	define wp constraints
2070	define quality requirements
2110	define QA procedures
2170	plan tests
2330	identify risk factors
2340	identify risk events
2350	manage risk assessment
2360	assess risk probability
2370	assess risk impact
2850	attention to constraint indicators by HR
2860	attention to guidance tools by HR

4.2 Quantitative content analysis

The basic quantitative analysis is a code frequency analysis. For the IT service provider this analysis was based on the assignment of 117 research codes (out of the 200 that appear in the codebook) to the 40 lessons learned documents that were generated during the year 2007. The frequency analysis of the codes assigned to the lessons learned of the IT company reveals that the most frequent items, which constitute about 19% of the total code assignments, are: define work package (wp)

responsibilities, define information transfer responsibilities, define work instructions and constraints, define information transfer requirements, distribute information to team members, control IT performance and optimization. This list of items can be summarized into topics: responsibilities, communication and resource planning and controlling.

Analysis of the codes assigned lessons learned documents, as related to process group yields the following results.

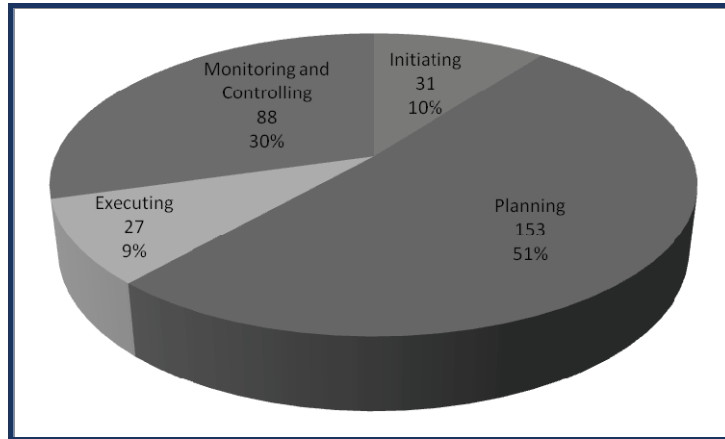


Figure 3: Process group frequency chart

An analysis of the distribution of the codes related to planning identifies the codes of define work responsibilities and define information transfer responsibilities as the most frequent ones. The secondary frequent codes are: define work instructions, define work constraints, and define information transfer requirements. Hence, the planning process, especially related to the topics of work planning and communications planning, is obviously problematic in the IT organization. Among the monitoring and controlling process group the most frequent codes were control of IT performance and optimization. Within the executing process group the most frequent code was distribute information to team members. The most frequent codes within the initiating process group were related to customer involvement and deliverable definition.

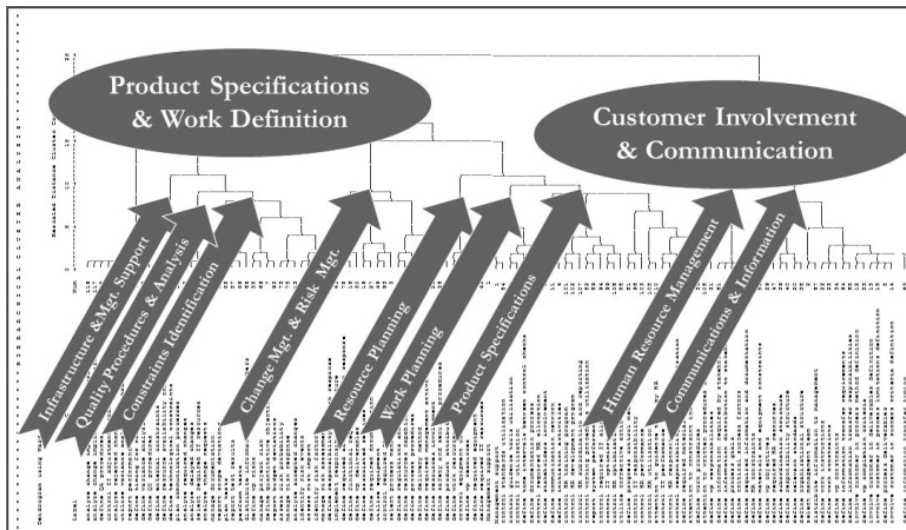


Figure 4: Dendrogram representation of hierarchical risk clustering

The visualized representations of the cluster analysis results are displayed in this dendrogram chart. It depicts the RBS (Risk Breakdown Structure) of the IT organization as derived from the content analysis of its lessons learned documents. The RBS hierarchical representation suggests an interesting classification of diversified risk items. The first level differentiates between issues of customer involvement and communications on one hand, and product description and the work required to produce it on the other hand. Each of these two major branches is further divided. The first branch refers to issues of infrastructure and management support; the second branch focuses on quality procedures and control analysis processes; the next branch refers to identification of

constraints; the following branch is involved with change management and risk management; the fifth branch concentrates on specific resource planning items; the next one relates to accurate definitions of the required work during the planning phase; and the following branch is directed towards a definition of the required resources; the two final branches are: issues related to human resource management; and, issues of information exchange.

5. Conclusions

The current study presents a methodology that integrates qualitative and quantitative methods to enable the identification of risk factors in high-tech companies. The methodology is based on the analysis of existing organizational information while transforming it into valuable managerial knowledge. The concept that associates risk management and knowledge management was articulated by Neef (2005) who argued that risk management *is* knowledge management. This research encompasses both risk management and knowledge management, which is a concept that is also supported by other studies (e.g., Kerzner, 1999; Williams, 2003; Perrott, 2007), into one homogeneous method that starts with existing information and ends with knowledge that emerges as a risk management plan.

The integration of qualitative and quantitative methods into one methodology yielded an in-depth understanding of the project and organizational risk factors and risk events that an organization might encounter. This understanding is of great importance especially in new product development projects (Grubisic, Gidel and Ogliari, 2011) due to the high level of uncertainty involved in this type of projects. It is interesting to find out that even in high technology projects the major influence of the identified risks was nevertheless related to the planning phase of communications, which manifested itself in a later phase as problems with human resource performance.

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Vered Holzmann

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Evaluating Determinants for ERP use and Value in Scandinavia: Exploring Differences Between Danish and Swedish SMEs

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Abstract: In the paper we present a research model for evaluating determinants of ERP value in small and medium-size enterprises (SMEs). The model is grounded in the diffusion of innovation (DOI) model and resource-based view of the firm (RBV) theory. The research model links six DOI determinants to explain 'ERP use' linked with two additional determinants to explain 'ERP value', on which nine hypotheses are postulated. The hypotheses were tested through structural equation modelling on a dataset from a web survey of 325 SMEs in Denmark (107) and Sweden (218). Through an empirical work we validate the theoretical arguments and provide insight into how SMEs use and value ERP, especially how perceived ERP use and perceived ERP value in Scandinavian SMEs can be explained. To our knowledge this is the first empirical research study on Scandinavian SMEs, thus adding a cross-country dimension to the innovation diffusion literature. Unlike the typical focus on ERP adoption in large firms found in the literature, this study focuses on post-adoption of ERP in SMEs. The main finding is that Danish and Swedish SMEs show different results despite the fact that they seem to be so similar. Our study reveals that while transactional efficiency, best-practices, and competitive pressure are important determinants of 'ERP use' in both Swedish and Danish SMEs, complexity is significant only among Danish firms. Compatibility has contrary effects, i.e., it is an inhibitor for Danish SMEs and a facilitator for Swedish SMEs to explain ERP use. Furthermore, while for Danish SMEs 'ERP value' is explained mainly by collaboration, for Swedish SMEs 'ERP value' is explained mainly by analytics. The facts that the research presents results focusing on SMEs makes it especially valuable since this is an under researched area, and that the research has 325 respondents also makes it important in exploring the differences and similarities between countries, adding an international dimension.

Keywords: ERP, SMEs, diffusion of innovation, resource-based view, use, value, post-adoption

1. Introduction

Some enterprise systems (ES), such as enterprise resource planning systems (ERPs) are more or less *a de facto* standard amongst large organizations. Lately, small and medium-sized enterprises (SMEs) have also showed a great interest in adopting ERPs. However, in the context of SMEs an interesting question is how decision-makers in SMEs perceive the value of the adopted system. The questions addressed in this paper are: how can perceived ERP use and perceived ERP value in SMEs be explained? From the results of those questions we then explore if there are differences between Danish and Swedish SMEs. Through this comparison we seek to increase the knowledge on determinants for what is seen as influencing gained value from a decision on adoption of ERPs in SMEs. This is of interest to stakeholders in the ERP value-chain. The vendors and providers of ERPs will gain a better understanding of what user organizations experience about gained value in the post-adoption phase of an ERP. The user organizations and also organizations that have not yet decided about adoption of ERP will gain knowledge on what they can expect as a result of adopting an ERP system.

We present a research model for evaluating determinants of ERP value in SMEs. The model is grounded in the diffusion of innovation (DOI) model and resource-based view of the firm (RBV) theory. The research model links six DOI determinants to explain 'ERP use' linked with two additional determinants to explain 'ERP value', on which nine hypotheses are postulated. Testing of the hypotheses was conducted through structural equation modelling on a dataset from a web survey of 325 SMEs in Denmark and Sweden.

The remainder of the paper is structured as follows. The next section presents a literature review giving the theoretical perspectives as well as the research design and hypotheses. The characteristics of

the survey data and the results are presented in Section 3. Section 4 then analyse the hypotheses. The final section then presents conclusions and some ideas for future research.

2. Theoretical perspectives and hypotheses

According to Nah, Tan and Teh (2004) ERP use means ERP utilization, which refers to the experience of managing the operation of the system software throughout the system's post-implementation stages. In line with literature, we consider ERP to be a type of innovation that is implanted in a firm's core business processes in order to leverage performance (Rajagopal, 2002; Zhu and Kraemer, 2005). Not only does it extend basic business and streamline integration with suppliers and customers, it also directs system usage to the firm's performance. Rogers' (1995) Diffusion of innovation (DOI) model aims to explain and predict if and how an innovation is used within a social system, with regard to performance at the firm level. Research conducted by Bradford and Florin (2003) verifies DOI determinants regarding successful ERP usage. Considering their findings, we believe that DOI has the potential to provide a favourable framework for explaining ERP use.

As information technology (IT) value relies on how firms strategically exploit it, firms' performance in a competitive environment is a subject that draws much attention and attempts to build explanatory theories. One of the most recognized is the resource-based view (RBV) theory, which states that firm-specific resources determine the firm's performance. It is linked to the competitive advantage approach to strategic management and can explain sustained advantages (Hedman and Kalling, 2003). In the IS literature, the RBV has been used to analyse IT capabilities as a resource and to explain IT business value. That is, IT business value depends on the extent to which IT is used in the key activities of the firm. The greater the use, the more likely the firm is to develop unique capabilities from its IT business applications (Antero and Riis, 2011; Bharadwaj, 2000; Zhu and Kraemer, 2005). Hedman and Kalling (2003) and Fosser *et al.* (2008) used RBV to extend Mata *et al.*'s (1995) framework for organizational and business resources and concluded that ERP systems are IT resources that can lead to sustained, competitive advantages. With this in mind, we believe that RBV has the potential to provide a favourable framework for explaining ERP value.

For these reasons, we next postulate six hypotheses to explain ERP use (Hypothesis 1 – Hypothesis 6) based on DOI literature, and three hypotheses based on RBV theory to explain ERP value (Hypothesis 7 – Hypothesis 9).

Hypothesis 1: ERP systems with high compatibility positively influence ERP use.

Compatibility is measured by the degree to which the ERP system matches IT features, such as compatibility with hardware and other software. Bradford and Florin (2003) and Elbertsen *et al.* (2006) concluded that the degree of compatibility of ERP will have a positive relationship with system adoption and use.

Hypothesis 2: ERP systems with high complexity negatively influence ERP use.

Cooper and Zmud's (1990) research indicates that system usage familiarity enhances job performance. Studies conducted by Kositanurit *et al.* (2006) and Chang *et al.* (2011) conclude that ERP complexity is a major factor affecting user performance.

Hypothesis 3: ERP systems with high transactional efficiency positively influence ERP use.

Bendoly and Kaefer (2004) assessed transactional efficiency and found that its communication over the ERP improves the firm's overall performance. Rajagopal (2002) found that transactional efficiency has a direct influence on ERP use. Business process benefits of ERP investment include transactional efficiency, where reliability effectiveness on the application improves user confidence. Along the same lines, Gattiker and Goodhue (2005) found that efficiency greatly benefits ERP use.

Hypothesis 4: ERP systems implemented best-practices positively influence ERP use.

From the perspective of business process reengineering, there are two main options in implementing ERP systems: modify/customize the system to suit the firm's requirements, or implementing the system with minimum deviation from the standard settings - adopting best practice - (Davenport, 1998). According to Chou and Chang (2008) and Maguire *et al.* (2010) the reason for adopting 'best-

practices' is the belief that ERP design does things in the right way. In line with Wenrich and Ahmad (2009), firms that implement industry best-practices dramatically reduce risk and time consuming project tasks such as configuration, documentation, testing, and training. Thus, we postulate that best-practices will positively influence ERP use.

Hypothesis 5: User training of ERP systems will positively influence ERP use.

Several researchers, including O'Leary (2000), Bradford and Florin (2003), and Maguire *et al.* (2010) state that one of the main determinants for the successful use of ERPs is training of users. They state that preparedness of users to carry out a planned sequence of actions without upstream errors has a positive impact on business. Providing knowledge and skills to employees on how to use the system improves familiarity and boosts its usage.

Hypothesis 6: Competitive pressure positively influences ERP use.

Competitive pressure has long been recognized in the innovation diffusion literature as an important driver of technology diffusion (Bradford and Florin, 2003; Oliveira and Martins, 2010b; Zhu and Kraemer, 2005). These studies have shown that innovation diffusion is accelerated by the competitive pressure in the environment. Thus, we postulate that competitive pressure plays an important role in pushing firms toward using ERP systems.

Hypothesis 7: ERP use positively influences ERP value.

Shahin and Ainin (2011) found that user fit on ERP is important to explain the ERP usage, and a successful adaptation with firms' processes and data flow from other systems makes ERP worthwhile. With ERP systems firms can form a specific resource that guides both internal and external collaboration and provides the repository to perform business analyses. As a result, it is only when firms actually use ERP systems to conduct business that it can have an impact on firm performance (Devaraj and Kohli, 2003; Zhu and Kraemer, 2005).

Hypothesis 8: Collaboration by ERP systems positively influences ERP value.

Calisir and Calisir (2004), Gattiker and Goodhue (2005), and Ruivo *et al.* (2012) support the conclusion that ERP systems help users to collaborate; up, down, and across their department, company, and industry ecosystem, increasing their productivity and the health of their firms and business partners. ERP allows both humans and applications to collaborate, from meeting service-level to supporting firm's performance. ERP provides users with a structured communication channel with the right information at the right time, resulting in increased efficiency and effectiveness. We believe that partnering with system and cross-group collaboration amplifies ERP value.

Hypothesis 9: Analytics exploited from ERP systems positively influence ERP value.

Davenport and Harris (2007) stated that firms generally use business analytics to gain competitiveness. The common data model and visibility across functional departments allows firms' metrics/KPIs to be unified and consistent. Although ERP systems are essentially transaction-focused on internal data, those firms that exploit ERP analytics capabilities can easily and quickly use data for managerial decision making and realize an advantage in their pursuit of sustainable performance (Chiang, 2009; Ruivo and Neto, 2010). We therefore suggest that analytics provides users with unique business insight information, and thereby positively influences ERP value.

3. Research methodology and data analysis

A web-survey was used for data collection and each item-question was reviewed for content validity by ERP experts. The initial questionnaires were pilot tested on 10 firms and some items were revised for clarity with assistance from the International Data Corporation. To ensure the generalization of the survey results, the sampling was stratified by country (Denmark and Sweden), by firm size (fewer than 250 employees), and by industry (finance, distribution, manufacturing, and professional-services). Questionnaires were translated into the two languages and sent in September and October 2011. In total, 600 (200 Danish and 400 Swedish) firms received the email survey, and 325 (107 Danish and 218 Swedish) valid responses were returned. Table 1 shows characteristics of the sample, regarding number of years using ERP, industry type, and position of respondent. In general it can be stated that

there are more similarities between Denmark and Sweden than there are differences in the sample. The biggest difference in the sample is the number of years using ERP, where there is a higher frequency of SMEs that have used ERPs for more than ten years in Sweden.

Table 1: Characteristics of the samples

	Sweden (N=218)	Denmark (N=107)
# years using ERP		
<2	12.4%	14.9%
2-5	21.6%	22.5%
5-10	23.8%	35.5%
>10	42.2%	27.1%
	100%	100%
Industry type		
Distribution	27.5%	27.1%
Finance	18.3%	21.5%
Manufacturing	33.1%	23.4%
Services	21.1%	28.0%
	100%	100%
Respondent type		
CEO, owner	30.2%	22.4%
Finance manager	18.8%	24.3%
IT/IS manager	10.2%	14.9%
Manufacturing manager	12.4%	8.5%
Sales manager	28.4%	29.9%
	100%	100%

The survey instrument was based on well-established scales as adapted to the context of ERP (see Appendix A). We performed the Kolmogorov-Smirnov test and confirmed that none of the items measured are distributed normally ($p < 0.001$). For this reason we used partial least squares (PLS), since this statistical technique does not require normal distribution. We used the SmartPLS software to estimate the model. We validate all the items in Appendix A, since all have loadings above 0.7 and are significant at ($p < 0.001$), in accordance with Chin (1998). Furthermore, it is shown that *composite reliability* (CR) and *average variance extracted* (AVE) for each construct are above the cut-off of 0.7 and 0.5, respectively (Hair, Anderson, Tatham and Black, 1998). The table with item loading and CR and AVE values is available from the authors on request. In short, our measurement model satisfies reliability and validity criteria. We tested the conceptual model by using the sample split between Sweden and Denmark. The control variables used were size and industry type. Figure 1 shows the path coefficients and t-statistics (in parentheses), as well the R^2 values for dependent constructs.

The analysis of hypotheses on the Swedish and Danish samples was based on the examination of the standardized paths shown in Figures 1(a) and (b), respectively. Regarding the Swedish sample, four out of six DOI determinants for 'ERP use' are statistically significant; complexity and training are not significant. Thus, H1, H3, H4, and H6 regarding 'ERP use' are supported, while H2 and H5 are not supported. In addition, the model indicates significant links between collaboration (0.343) and analytics (0.361) to 'ERP value', meaning that both H8 and H9 are supported, while H7 (ERP use to ERP value) is not statistically significant. Regarding the Swedish sample, through R^2 value examination this model explains the variability of 'ERP use' in 42.4% and 'ERP value' in 43.6%. In the Danish sample, for 'ERP use', five out of six DOI determinants are found to be significant, while training is insignificant. Compatibility was expected to be positive, but it is negative. Complexity was expected to be negative and, so it is. Therefore, H2, H3, H4, and H6 for 'ERP use' are supported, while H1 and H5 are not supported. Also the Danish sample shows a not significant link between 'ERP use' and 'ERP value', hence H7 is not confirmed. As in the Swedish sample, the Danish sample shows a significantly positive association of collaboration and analytics with 'ERP value'. Hence, H8 and H9 are supported. Again, with regard to the Danish sample, through R^2 value examination, this model explains variability of 'ERP use' in 52.0% and 'ERP value' in 45.9%.

In a deeper analysis, we tested the differences between the path coefficients across Swedish and Danish samples. Table 2 shows that regarding 'ERP use', training as well as efficiency does not show a statistically significant difference ($p > 0.10$) between countries, being equally important for both Swedish and Danish SMEs. Whereas best-practices is a more important factor for Danish SMEs, competitive pressure is more important for Swedish SMEs. Moreover, compatibility and complexity

are found to be important inhibitors for Danish SMEs firms when compatibility is a facilitator for Swedish SMEs. Regarding complexity, it is also an inhibitor for Swedish SMEs even if it is not seen as such a “strong” inhibitor for Danish SMEs. Regarding ‘ERP value’; ‘ERP use’ is not a statistically significant difference ($p > 0.10$) between countries, which means that ERP use is understood as being equally important for both countries, SMEs. Collaboration is seen as more important for ERP value among Danish SMEs while analytics is a more important factor for Swedish SMEs when it comes to perceived ERP value.

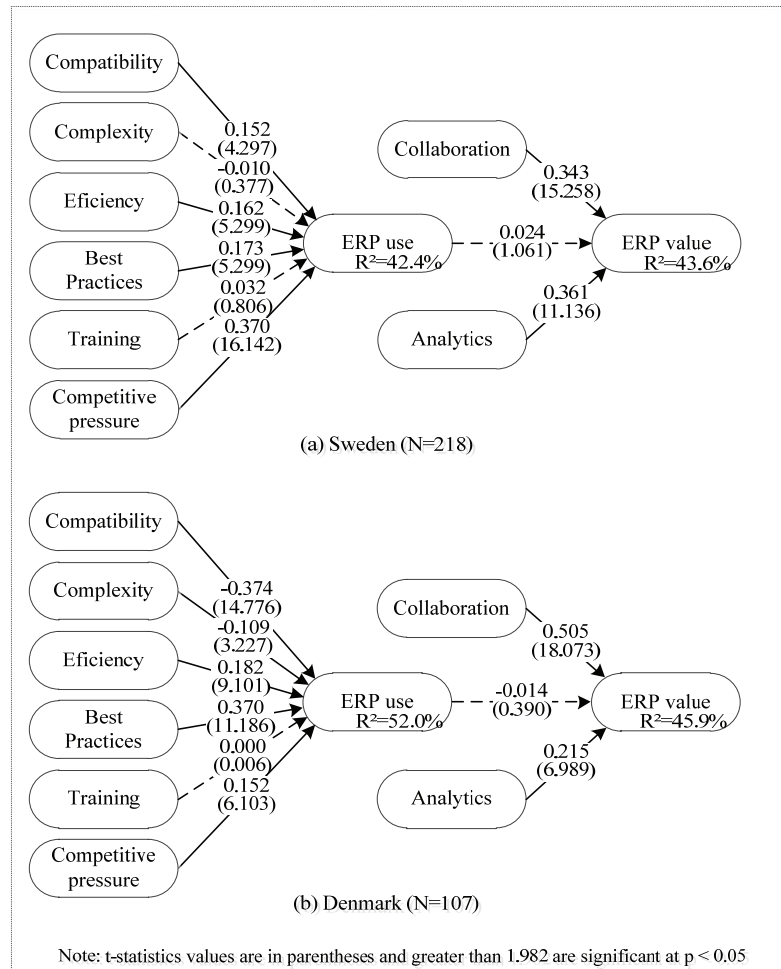


Figure 1: Research model, path models of Sweden and Denmark SMEs

Table 2: Results of pooled error term t-tests

		Sweden		Denmark		Comparison (Sweden-Denmark)	
		Path co-eff.	SE from bootstrap	Path co-eff.	SE from bootstrap	t-Stat.	p (2-tailed)
Compatibility	ERP Use	0.152	0.035	-0.374	0.025	12.102	0.000
Complexity		-0.010	0.026	-0.109	0.034	2.350	0.019
Efficiency		0.162	0.031	0.182	0.020	-0.559	0.576
Best-Practices		0.173	0.032	0.370	0.033	-4.262	0.000
Training		0.032	0.040	0.000	0.025	0.686	0.493
Competitive pressure		0.370	0.023	0.152	0.025	6.459	0.000
ERP Use	ERP Value	0.024	0.023	-0.014	0.036	0.902	0.367
Collaboration		0.343	0.023	0.505	0.028	-4.509	0.000
Analytics		0.361	0.032	0.215	0.031	3.275	0.001

4. Discussion

The purpose of this research was to identify determinants that explain ERP use and ERP value, and the magnitude variation across Swedish and Danish SMEs. Empirical results support our theoretical

model, and all hypotheses have been tested. Academic and managerial implications are discussed below. Although both paths associated with collaboration and analytics are significantly positive, in the Danish sample collaboration is much stronger, whereas analytics is much stronger among Swedish SMEs, as shown in Table 2. This difference might be explained by the fact that Swedish SMEs have been using ERP for a longer time than Danish SMEs (Table 1). Thus, not taking full potential in exploiting data analytically, and aligned with Buonanno *et al.* (2005), ERP starters confer more value to collaboration because it is often connected to the organizational enhancements. However, the difference in the samples regarding number of years is not great enough that it alone could explain the difference. But, if also taken into consideration that Danish have a higher number of service organizations and stipulating that service organization demands more collaboration it could be that both these characteristics explain the difference. While the link between 'ERP use' and 'ERP value' is found to be not significant, it can be stated that there is no difference between Swedish and Danish SMEs in this respect.

Furthermore, although competitive pressure, best-practices, efficiency, and compatibility are significant, their importance differs across Swedish SMEs and Danish SMEs, as shown in Table 2. The underlying rationale would be that the number of years using the system influences 'ERP use'. This conclusion might be explained through cross-country analysis. First, although compatibility and efficiency have significant paths for both Swedish and Danish SMEs, compatibility shows a negative result for Danish SMEs. This may also be explained by the weaker relationship that Danish SMEs gives for the relationship between analytics and ERP value. The explanation could be that if analytics is not seen as that important, it could also be that the linkage between different data sources (compatibility) is also not seen as an important determinant for ERP use. Hence, technological characteristics such as compatibility with other hardware and software, and transactional efficiency depend on the system stability, which requires use over time. As a result, ERPs with less customization (using standard protocols and best practices) are more suited to face compatibility issues (Buonanno *et al.*, 2005; Nicolaou and Bhattacharya, 2006). Second, following our predictions, and in line with the conclusions of Bradford and Florin (2003), Kositanurit *et al.* (2006), and Chang *et al.* (2011), our findings reveal a negative effect of system complexity on 'ERP use'. However, it is not statistically significant for Swedish SMEs. It has been widely believed that complexity of business applications is an inhibitor to use, but from our results we could only provide evidence for this in the Danish sample. Competitive pressure is statistically significant for both Swedish and Danish SMEs, but is stronger for Swedish SMEs. This reveals that competitive pressure is a subject where analytics plays a critical role in gaining business advantages.

The results have several important implications for management. In the first place, as ERP diffuses through greater use, and becomes a necessity, the competitive pressure infuses IT-enhanced capabilities such as collaboration and business analytics, which are major sources of ERP value. Our analysis shows that the relationship between training and ERP use is not found to be statistically significant, which is a surprise. However, that could probably be explained by the fact that in both cases Swedish and Danish SMEs have used ERPs for many years. Best practices shows a stronger linkage amongst Danish SMEs than amongst Swedish SMEs, as does collaboration. This provides indications for managers on what the ERP is used for and could therefore be used for managers as a decision point when making the decision on what specific ERP solution to implement. Lastly, our study also offers implications for software makers; ERP complexity, business analytics, and business collaboration functionalities have emerged as important factors for ERP use and value. This paper has some limitations that may form the starting point for further research. First, although our study shows evidence that use and value importance vary across-countries in association with the number of years using ERP, we cannot speak empirically about the issue of whether the maturity stages play a role, because this would require an adoption process life-cycle study. An interesting different direction could be to study the maturity stages of ERP. Second, although data cover several industry types, some biases may have been introduced; perhaps different industries have different operating characteristics and environments, and the factors related to ERP use and value may differ accordingly (Oliveira and Martins, 2010a). Consequently, we encourage further studies comparing industries.

5. Conclusion

Via an empirical study among Scandinavian SMEs we evaluated a research model for assessing ERP use and ERP value at the firm level based on *diffusion on innovation* and *resource-based view theory*. While use and value are usually studied separately, our study proposes that use and value are closely associated for the post-adoption stages of ERPs. Besides being the first model applied to Scandina-

vian SMEs, our study contributes to the literature by adding an international dimension and by moving beyond dichotomous “adoption versus non-adoption”, linking ERP value creation to collaboration and analytics. For ‘ERP’ use, our study has examined six DOI determinants; whereas competitive pressure, best-practices and transactional efficiency are important to both Swedish and Danish SMEs, cross-country analysis also shows complexity to be an important inhibitor for ‘ERP use’ among Danish SMEs, but not significant among Swedish SMEs. For ‘ERP value’ our study demonstrates that collaboration and analytics contribute to value creation from ERP. Moreover, our study reveals that while collaboration is more important for Danish SMEs, analytics is more important for Swedish SMEs. The main conclusion is that Danish and Swedish SMEs present significant different results despite the fact that in general they seem to be so similar.

Appendix A: Measures

Respondents were asked to rate their perception of...		
Construct /Items		Scale
Compatibility (Bradford and Florin, 2003):		
CB1	...with others' software.	1~5
CB2	...with others' hardware.	1~5
Complexity (reverse code) (Kositanurit et al., 2006):		
CX1	...intuitiveness of the system.	1~5
CX2	...how comfortable users feel using it.	1~5
Efficiency (Rajagopal, 2002):		
EF1	...effectiveness in executing repetitive tasks.	1~5
EF2	...effectiveness of user interface.	1~5
EF3	...speed and reliability of system.	1~5
Best-Practices (Wenrich and Ahmad, (2009):		
BP1	...set up of the application.	1~5
BP2	...map workflows based on local requirements.	1~5
BP3	...system adaptability to business needs.	1~5
Training (Bradford and Florin, 2003):		
TN1	...understanding of the content training material.	1~5
TN2	...applied to daily tasks.	1~5
Competitive Pressure (Oliveira and Martins, 2010b):		
CP1	...experienced competitive pressure to use ERP.	1~5
CP2	...firm's competitors affects your landscape market.	1~5
ERP Use (Zhu and Kraemer, 2005):		
ERPU1	...how much time per day do employees work with the system?	%
ERPU2	...how many reports are generated per day?	%
Collaboration (Gattiker and Goodhue, 2005):		
CO1	...collaborate with colleagues.	1~5
CO2	...collaborate with the system.	1~5
CO3	...communicate with suppliers, partners, and customers.	1~5
Analytics (Ruivo and Neto, 2010):		
AN1	...comprehensive reporting.	1~5
AN2	...real-time access to information.	1~5
AN3	...data visibility across departments.	1~5
ERP Value (Zhu and Kraemer, 2005):		
ERPV1	...user satisfaction.	1~5
ERPV2	...individual productivity.	1~5
ERPV3	...customer satisfaction.	1~5
ERPV4	...management control.	1~5

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User Experience in Mobile Phones by Using Semantic Differential Methodology

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Abstract: Measuring overall UX is a challenging process because of its versatile nature. Studies showed that hundreds of thousands of products are returned each year not because of its functional behaviour but because of its bad user experience. Researchers and practitioners use different techniques and methods to capture the customer psychological and behavioural aspects towards a product and to put it into design so that the future product form must be in according to his/her expectations. In this paper a research work is carried out to evaluate user experience evaluation methodologies and to identify a method which can be used efficiently to measure the overall user experience of a product use from user experience using mobile phone as a case. As overall user experience constitutes both the experiential as well as non- experiential aspects of a product. Hence semantic differential methodology is identified as a best suited method based on current user experience evaluation methodologies and later on used to measure preference from the overall user experience which can be used to improve product form to ensure customer loyalty.

Keywords: semantic differential (SD), user experience (UX), overall user experience, user preferences, UX metrics

1. Introduction

In daily life a person is encountered with a wide range of products and share different experiences. As human experience is complex and evolve all the time therefore very difficult to measure. Both experiential and non-experiential experience make it complex due to which it becomes dynamic, complex and subjective; therefore the success of technology adheres to experiential as well as the non experiential aspects.

The authors used semantics covering broadly the overall user experience of technology use such as social, emotional, aesthetic, fun, joy, cool and mood etc to measure overall user experience. The authors' also claimed that SDM can be used to measure overall user experience in order to identify user preferences in short time and with less resource consumptions. The results obtained through this methodology resulting in positive experience indicate satisfaction while preferences resulted in negative experience indicating improvements needed in product form. Preference indicates that product form can be improved accordingly to achieve satisfaction and loyalty.

2. User experience theory

User experience is ubiquitous. The user churns the experience the moment he start using the product. As UX is a resultant of behavioural, temporal and psychological aspects. Therefore, it is very crucial to know UX evaluation and its results on product development. Therefore, before starting evaluating the non experiential aspects of products, one needs to understand the actual meaning of 'user experience evaluation'. In order to do so, five steps have been considered in below paragraphs to develop a systematic way to evaluate user experience.

User Experience

To gain a common understanding about UX and make science out of it, we should be able to formulate a definition that everyone can agree on. There are a number of UX definitions out there; below are few of them.

"All the aspects of how people use an interactive product: the way it feels in their hands, how well they understand how it works, how they feel about it while they're using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it" (Hassenzahl & Tractinsky, 2006). This definition fits well according to the overall UX. It defines their identity factor, "the way it feels in their hands", aesthetics, "how they feel about it while they're using it", utility, "how well it serves their purpose", stimulation "how well it fits into the entire context in which they are using it".

Other definitions which are suitable according to overall UX aspects are:

Kuniavsky believes that the precise definition of user experience is very difficult; because user interacts with others and in return the user experience is made omnipresent by the environment (Kuniavsky, 2003). International Standard Organization (ISO) has its own view of defining user experience. According to the current version, it is defined as “a person’s perceptions and responses that result from the use of anticipated use of a product, system or service” (ISO, 2008). Similarly, according to Usability Professionals Association (2007), “Every aspect of the user’s interaction with a product, service, or company that makes up the user’s perceptions of the whole”. Logan et al (1994) argued for the importance of whole range of specific non pragmatic needs such as surprise, diversion or intimacy to be addressed by technology. “Drawing upon the concept of emotional usability”. Hassenzahl asserts that future HCI must be concerned about the pragmatic aspects of interactive products as well as about hedonic aspect, such as stimulation, identification and evocation so that his multidimensional model explicitly links product attributes with needs and values that could facilitate in the evaluation of UX (Hassenzahl, 2003). Similarly, according to Mäkelä et al (2001), “Result of motivated action in a certain context”. “The user experience considers the wider relationship between the product and the user in order to investigate the individual’s personal experience of using it” (Hassenzahl, 2006).

Components of User Experience

The aim of measuring user experience is to consider a more comprehensive user centred approach that takes also aspects into account which go beyond usability. One approach for defining the components of user experience is to characterize specific dimensions that are important aspects in the experience of a product. For this purpose, Hassenzahl, distinguishes two dimensions of product qualities, namely the perception of instrumental (or: ‘pragmatic’) and non-instrumental (or: ‘hedonic’) qualities (Jordan, 2000). The importance of those aspects is motivated by their immediate understandability. While usability evaluation depends basically on interaction with the product, the attributes that enable hedonic judgments are inherent in the product appearance itself.

A third important aspect of user experience is emotional user reactions. For example, in his hierarchical model, Jordan distinguished several types of pleasure with a product, whereby he insists on high functionality and high usability as necessary preconditions (Karapanos et al, 2008).

User experience metrics

UX is a subjective and holistic concept; it is not easy to define a set of criteria against which it could be evaluated, but there are user experience evaluations where the participants evaluate the product against the personal criteria (Norman, 2009). This way of metrics setting is very interesting as it well addresses the subjective nature of user experience.

From product creation perspective, each product aims at certain user experience, e.g. fun, trust, or relaxing. In this case, it is useful to define metrics from the product’s perspective rather than from each individual’s perspective. UX is more dynamic therefore it is very hard to define its metrics. Some practitioners evaluate aesthetics while others look for emotional aspects. Hence UX can be momentary, episodic and long-term adding value to product design.

User experience evaluation methods

UX is a complex concept that requires specific evaluation techniques in order to consider its all aspects. These techniques can be very resource consuming, including people, time, and money. Therefore cost-effective evaluation techniques are of a great importance.

Numerous potential criteria for applicable methods are obvious from literature; therefore one method will not serve all purposes (Osgood, 1952). A set of methods should form a “User experience evaluation tool kit” so that user experience practitioners can select an applicable method for each case. There are methods developed for examining user’s momentary emotions during interacting with a system (Chang et al, 2002) or for analysing the emotions after interaction (Guo, 2010). In user experience literature, a movement from emotion assessment towards a longer period of time has also been noticed (Azhari, 2007). This movement means a change in the way user experience is evaluated

and one should not only investigate momentary emotions but also examine how users experience a product as a whole during a longer period which results in satisfaction.

There exist a number of methodologies to evaluate non-experiential aspects of technology use in a particular context with particular system and mode of use but no specific method found in the literature to measure overall user experience. From the literature review we came across various UXEMS but they can be used as momentary, episodic or long-term. They are highly time consuming and difficult to run emotion analysis. They require high skills to evaluate user experience and difficult to interpret user results. Some of methodologies found after conducting literature review are as follow.

- Repertory Grid Technique
- Experimental Pilots
- SAFE Method
- Web Based Surveys
- Diary Method
- Interviews
- Heuristic Evaluation Methods
- Cognitive Walkthrough

Integrate user experience evaluation into product development

The basic user-centred design principles apply for user experience design as well. We should first consider users' needs and wants in selected contexts, then iteratively design and evaluate the concepts during the product development process. The methods are different in different phases of product development: in the very early phases, concept ideas can be evaluated with surveys. Resource-efficient user experience evaluation methods help introducing user studies as new activities into the companies that have not followed user-centred design earlier. The goal of user evaluation is to ensure that all products will be valuable and enjoyable for the target users, and this pay backs in customer satisfaction to ensure customer loyalty.

3. Factor analysis

Thurstone (1947) was the originator of factor analysis, which was developed in the area of psychometrics. Nowadays, the method is frequently used as a statistical data reduction technique to explain variability among observed random variables in terms of fewer unobserved random variables called factors. The technique is used in many fields, including economics and sociology. The method can now be implemented easily using convenient software packages, even by users who lack detailed knowledge of mathematical background. Factor Analysis is normally used to identify underlying communalities amongst the scales employed. The most frequently obtained communalities or factors are.

- Evaluation, defined by adjectives such as liked- disliked, positive- negative, honest- dishonest,
- Potency, defined by heavy- light, strong- weak, hard- soft.
- Activity, defined by adjectives such as active- passive, hot- cold, fast- slow.

4. Semantic differential methodology

SDM is recognized as a useful method for measuring person's semantic images of a concept, and many examples have been reported, applied in various areas. It has proven to be flexible and reliable instrument for measuring attitudes to a wide range of stimuli. The method normally employs rating of stimuli by using bipolar scales. Each bipolar scale is defined by a pair of adjectives with contrasting meanings such as Fast- Slow, Cheap- expensive.

Semantic differential is a method use to evaluate overall user experience not only in a short period of time with less resource consumptions but also produce satisfactory results. Azhari (2007) highlighted the importance of the methodology of market research and feedback with known demographic profiles for better design using semantic differential methodology with multidimensional scaling approach. The study was conducted in two different countries, Australia and Malaysia. It was claimed that the degree of satisfaction towards a particular product lies in the perceived value of users of different age groups.

Users of different age groups behave differently towards the same product use, because there exist differences in the consumer's behaviour. In this study SD method was used to evaluate the preferences and image perceptions of mobile phones. In another study Green et al (2009) identify the parameters of customer satisfaction and loyalty for mobile phones. Impact of perceived customer value, perceived service quality, trust on customer and the influence of satisfaction on loyalty was investigated. A questionnaire survey was used to collect data customer preferences on above mentioned artifacts. It was found that customer satisfaction and loyalty is predicted by trust and emotional value. It was also further concluded that perceived service quality is a significant factor influencing trust which affect customer satisfaction and cause changes up to an extent in loyalty.

In this paper the authors used semantics covering broadly the overall user experience of technology use such as social, emotional, aesthetic, fun, joy, cool and mood etc to measure overall user experience. It is also claimed that SDM can be used to measure overall user experience in order to identify user preferences in short time and with less resource consumptions. The results obtained through SDM resulting in positive experience indicate satisfaction while preferences resulted in negative experience indicating improvements needed in product form. Preference indicates that product form can be improved accordingly to achieve satisfaction and loyalty.

5. Research methodology

Research methodology is a plan or strategy to conduct a research work in a scientific way and link methods to outcome (Creswell, 2002). It defines how to develop research activity and what measurement should be used to advance the research and achieve research goals.

In this paper the work presented is the confluence of two approaches and answers to the problems are sought through the following methodologies.

- Literature review
- Survey

In first phase, detail explorative literature review is conducted; from literature review the relevant latent constructs which affect customer loyalty are identified. The identified constructs are based on user experience. The role of SD in UX studies to achieve customer satisfaction and loyalty is identified. First phase is helpful to know the empirical evidence of Semantic Differential Methodology.

In second phase, the author used data collection method questionnaire (survey) with the students of BTH (Blekinge Institute of Technology) to understand their experience of using mobiles to measure overall UX. The questionnaire is based on semantic differentials of bipolar pairs of adjectives. Initially all possible pair of adjectives are selected which best explain psychological aspects of customers, pragmatic and hedonic qualities of mobile phone products and they were selected from literature used explicitly for mobile phone products evaluation. These pair of adjectives served as characteristics or attributes which best explain user's perception and overall UX of customers from a mobile phone product. A survey is conducted in order to collect user evaluation data on mobile phones by using SD method.

After getting user evaluation data, factor analysis has been conducted to identify best possible factors which show customer preference coming from overall UX of mobile phone products. Questionnaire significance is tested statistically through Cronbach's alpha value (Cronbach, 1951). For research purposes alpha should be more than 0.7 to 0.8. Models have been constructed by author using stepwise regression analysis of customer preferences for mobile phones. The models shows a strong relationship of the customer preferences to mobile phone experience and carries an explanation of various parameters of experience that if implemented in design, the future mobile phone product will not only exhibit satisfaction but also increase profitability and will ensure loyalty.

6. Results

The author mainly concluded from LR results that SDM can be used in conjunction with satisfaction in order to evaluate overall UX and to identify user preference. Literature review results indicate that SDM is used in evaluation of UX in different contexts. Therefore, author used this method as a method of investigation to identify the role of SD to evaluate pragmatic and hedonic aspects of UX along with measures of the UX. The author identified satisfaction being used as a measure to evaluate UX as 72% as show in Table 1. The selected papers were studied and 16 out of 22 provide

the evidence of satisfaction as a measure to evaluate UX. 13 out of 22 papers provide the evidence of hedonic factors that is 59% while 11 out of 22 papers shows pragmatic use i.e. 50%. Other measures of UX; emotion and expectation were 45% respectively identified.

Table 1: Total number of occurrences of factors/ Methodology

Factor/ Method of Investigation	Number of Occurrences	Percentage
Satisfaction	16/22	72
Hedonic	13/22	59
Pragmatic	11/22	50
Emotion	10/22	45
Expectation	10/22	45

Second phase is based on empirical study conduction. This phase mainly served as to put the information collected from first phase into practical example in order to identify user preferences through SDM. To do so, initially 52 different semantics of factors like aesthetics, emotions, identity, utility and stimulation were selected from literature for collecting UX data. Semantics are collected from literature used in different studies to evaluate user experience. The semantics were grouped together according to Osgood distribution of bipolar adjectives Activity, Evaluation and Potency accordingly (Osgood, 1952). Pilot survey, was conducted in order to define scale and finally 31 semantics were selected for final data collection as shown in Table II below.

Table 2: Distribution of adjectives according to Osgood [13]

Activity		Potency		Evaluation	
Adjective	Antonym	Adjective	Antonym	Adjective	Antonym
Practical	Decorative	Unadorned	Splendid	Traditional	Modern
Adoring	Practical	Masculine	Feminine	Popular	Individual
Geometrical	Streamline	Complex	Concise	Hand-made	Hi-tech
Abrupt	Unisonous	Inconvenient	Convenient	Rough	Delicate
Pointed	Rounded	Babyish	Mature	Mediocre	Noble
Hale	Fluid	Dull	Captivating	Heavy	Light
Cheap	Expensive	Tardy	Streamlined	Clumsy	Clever
Normal	Particular	Sharp-edge	Curvature	Cautious	Bold
Conventional	Inventive	Repelling	Appealing	Coarse	Delicate
Undemanding	Challenging	Indistinct	Distinct	Rejecting	Inviting
Disagreeable	Agreeable				

SD data collection sheet was used to collect data. Data was collected from 21 participants' mainly BTH (Blekinge Institute of Technology) students for further analysis. A statistical technique named factor analysis was employed in order to form groups of semantics exhibiting particular characteristics. Each group is formed on the basis of likelihood of characteristics of same semantics of various factors. There are 9 factors whose Eigenvalue is greater than one, but only first four factors were selected as the remaining factors have very few semantics to be considered for further analysis as shown in Table III and figure no 1 respectively.

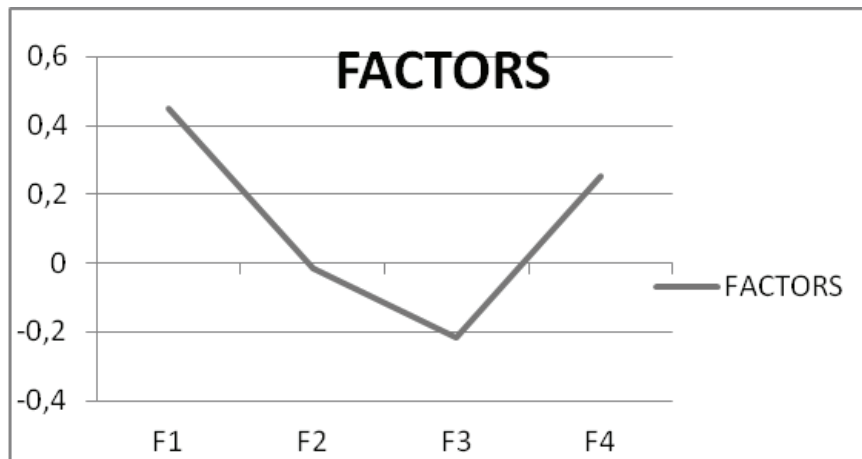


Figure 1: Factor analysis chart

Above Figure no 1 represents the semantic representation of the factors identified in UX through SDM. The average values of the four factors for the evaluated product are also plotted in the above figure. F1 represents positive experience for Pragmaticity factor. While F2 (Practicality) is neutral. Whereas F3 (Activity) is turned out to be negative from UX perspectives. F4 (Structural) represents positive experience in UX; showing that the product has good shape but need improvement.

Table 3: Factors with Eigenvalue greater than 1

Eigen values									
	F1	F2	F3	F4	F5	F6	F7	F8	F9
Eigen values	.470	.867	.349	.126	.036	.757	.324	1.185	.043
Variability (%)	4.097	2.475	0.803	0.085	.569	.668	.272	.823	3.366
Cumulative (%)	4.097	6.573	7.376	7.461	4.030	69.697	73.969	77.792	81.158

There are 17 factors but only nine factors that the initial Eigenvalue was over 1 and whose Extraction Sums of Squared Loadings was up to 81.158 were selected as shown in above Table III . It could be further interpreted in figure no 2 below.

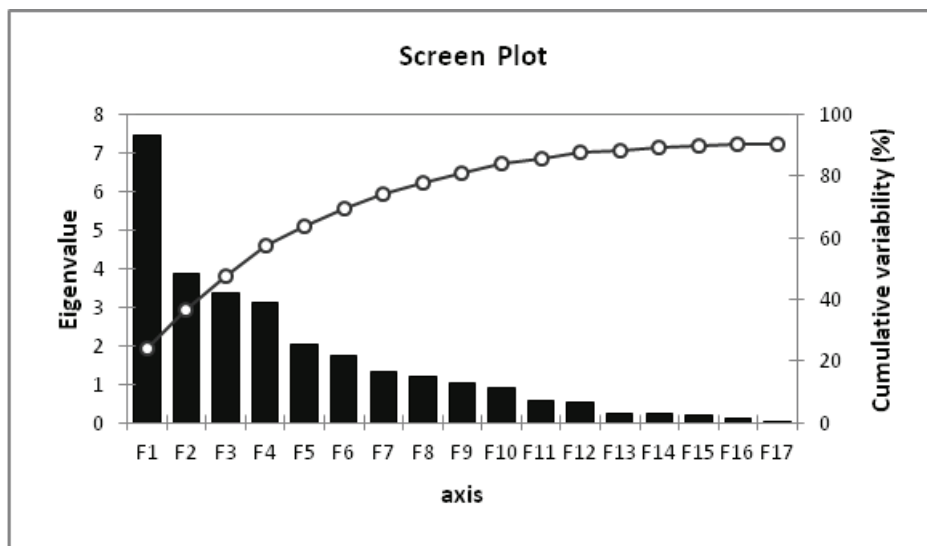


Figure 2: Eigenvalues plot

Based on factor pattern analysis and the underlying communalities of adjectives in each factor, four factors were selected for final analysis and that is the reason being very less number of variables in particular factor categories used. Factor loadings, where Eigenvalues greater than 1 extracted from final data set as shown in figure no 2. The semantic differential chart computed from the final survey is provided in figure no 3. The mean values of the opposite pairs of adjectives are computed. Extreme values are of particular interest. The extreme values give an idea that which characteristics are particularly critical and need more improvement or particularly well resolved.

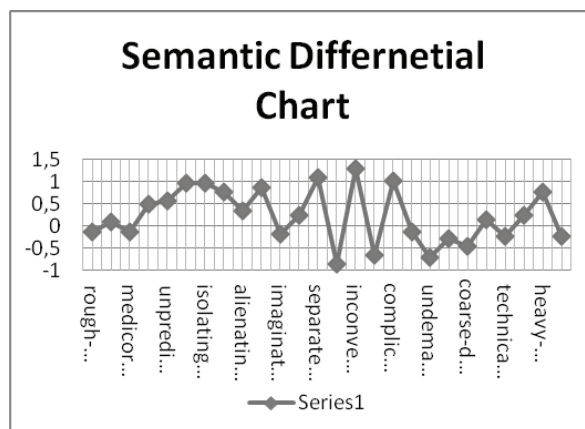


Figure 3: Semantic differential chart

Figure no 3 represents that overall UX of mobile phones from usability point of view and functionality wise is satisfactory and showed positive experience. While from practicality point of view there is more negative experience observed. The experience showed that mobile phone form should be in a way which is more practical, convenient and should be simple and normal. While from activity and structural wise more negative experience is observed.

The semantic differential chart in Figure no 3 computed from SD data represents the customer aesthetics, expectations, emotion and identity. The positive values on scale represent customer satisfaction while negative needs improvement.

7. Conclusion

The main purpose of this paper is to propose a methodology that is used to measure overall UX to explore various user preferences suitable for product form improvement. Semantics of various factors (aesthetics, emotions, expectations, fun, and joy etc) were used to measure overall UX. A set of product semantics along with user preferences were identified. To improve product form it is necessary that it should not only satisfy functional requirements but it should also satisfy customers' psychological needs subjectively to guide users with life experience. Various methodologies and tools used to measure UX were studied in the light of their strengths and weaknesses. There is no evidence found in literature about a specific user experience methodology to measure overall UX. The importance of non-experiential perspective of technology use and its worthiness in design is explored. Product specific semantics used to measure overall UX were identified. It is found that there is no definite set of metrics which can be used to measure UX rather it depends on study type and environment. Furthermore, satisfaction was used as main metric to measure overall UX. Satisfaction was measured using various factors semantics such as emotions, aesthetics and expectation etc.

8. Future work

SDM was used to measure overall UX in order to identify user preferences. Semantic chart provides an explanation of the weak design form of the product. It is suggested that SDM should be compared with other self reporting techniques and observe its effectiveness.

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Kalimullah Khan

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