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ADDRESSING TACIT KNOWLEDGE IN ISD METHODOLOGIES

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1. INTRODUCTION

This paper identifies a gap in ISD methodologies regarding the exclusion of tacit user requirements in the development of information systems (IS). It recognises that this will lead to IS failure, since given that tacit requirements are not considered or incorporated, these systems will not address these types of requirements. In the mid 90's Clegg *et al* (1997) argued that 80-90% of IT investments do not adhere to the performance objectives of the user. They identified a number reason for systems failure, one of them being the poor articulation of user requirements. Tacit knowledge is inarticulable (Wong & Radcliffe, 2000) and subjective (Baumard, 1999). Therefore requirements that result from tacit knowledge use are omitted from consideration in current ISD processes. This paper identifies three characteristics and five acquisition dimensions of tacit knowledge that have a significant impact upon the ISD process. Four well-known ISD methodologies are then critiqued in relation to these. This leads to a revised perspective on current ISD methodologies, which challenges the traditional view regarding the development of systems.

2. CHARACTERISTICS & ACQUISITION DIMENSIONS OF TACIT KNOWLEDGE & THEIR IMPACT ON ISD

This section defines tacit knowledge, and identifies how it can be transferred throughout the organisation. The major characteristics and acquisition dimensions of tacit knowledge and the impact they have on the development of IS are identified. Tacit knowledge is non-codifiable intelligence that is acquired through the informal take-up of learned behaviours and procedures (Howells, 1996). It is defined as "knowing more than we can tell", meaning that we know how to execute a certain task, but we cannot explain to another person (s) how to successfully perform that task (Polanyi, 1961, p93). Tacit knowledge is completely embodied in the individual; it is inherent in their practice and

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expertise. It can only be a transmitted through proficient execution and through a learning cycle that involves demonstrating and imitating (Fleck, 1997).

Stapleton (2001) states that many methodologies employed in ISD continue to focus on the creation of an information-processing *machine*. Social aspects and how they impact upon ISD are often ignored. Consequently, certain areas of knowledge have generally been omitted from consideration in current ISD methodologies. Tacit knowledge plays a major role in organisational information processing and decision-making that computer-based IS are designed to specifically support. Consequently, it follows that ISD must address tacit knowledge if it is to comprehensively support organisational information processing. However, tacit knowledge does not fit into the structured, rationalistic, and mechanistic viewpoints, which dominate many approaches to ISD. In the literature a number of important attributes for tacit knowledge were identified and a tacit knowledge framework was developed. These traits can be divided into three characteristics and five acquisition dimensions of tacit knowledge for this research. The three characteristics are implicitness, personal and non-measurability, while the dimensions for acquiring tacit knowledge are experiencing, interacting, showing-how and contextual learning which is sub-divided into social and cultural learning. Each of these are important aspects of organisational knowledge, which impact upon various aspects of ISD. This paper will now review each of these in turn, focusing upon their impact upon ISD.

2.1 Implicitness & Its Impact On ISD

Throughout the literature tacit knowledge has been defined as a nebulous process, intuitive (Howells, 1996). It is highly idiosyncratic (Roberts, 2000), subsidiary awareness (Polanyi, 1961), is inarticulable and non-analytical (Wong & Radcliffe, 2000). It is deeply rooted in the ideals, values or emotions of individuals and is typically learned and transferred through experience (Nonaka & Konno, 1998). When developing an IS the analyst must take this type of know-how into consideration. It is from this knowledge that the user will 'see' the outcome of his actions before they are implemented.

2.2 Personal & Its Impact On ISD

This has been defined as person-embodied (Howells, 1996; Wong & Radcliffe 2000), second nature, and intuitive (Wong & Radcliffe, 2000). Tacit knowledge is subjective and also includes good feeling [s] (Grant & Gregory, 1997). This form of knowledge is inbuilt into the individual's subconscious and may or may not be based on past experiences. The personal trait of tacit knowledge can be linked to Senge's 'Mental Models' (Polanyi, 1966). Senge describes mental models as "intuitions and 'gut instincts' that are difficult to communicate and share" (Senge & Fulmer, 1993, p22). Tacit knowledge is embodied in individuals within the organisation. It is this knowledge that the individual uses to make his decision. Senge (1990) states it is the individual's mental models that allow him to make sense of the world and also to determine what action should be taken. IS support the decision-making process, therefore the personal knowledge residing in each individual within the organisation who will be using the new IS needs to be considered. An emphasis upon the individual's personal knowledge is therefore critical if we are to address tacit knowledge in the ISD process.

2.3 Non-Measurability & Its Impact On ISD

Tacit knowledge is difficult to quantify (Howells, 1996), is un-codifiable, and dynamic (Howells, 1996; Grant & Gregory, 1997). Also, it escapes observation and measurement, as it is elusive and indeterminate (Baumard, 1999). This poses a problem for the analyst conducting the requirements phase of ISD. Requirements capture is traditionally carried out at the start of new systems development. However, since tacit knowledge is elusive and does not remain static, therefore this paper suggests that the requirements phase be conducted throughout ISD so as to include tacit knowledge.

Implicitness, personal and non-measurable are the three characteristics of tacit knowledge and the impact they have upon the ISD process. The following are the five acquisition dimensions of tacit knowledge identified from the literature and the impact each has on ISD:

2.4 Interacting & Its Impact On ISD

This acquisition dimension is described as an 'in the corridor' style of learning that is codified in local practices and communities (Wong & Radcliffe, 2000). It is culture bound; the knowledge is developed interactively through socialisation between individual co-workers (Grant & Gregory, 1997; Wong & Radcliffe, 2000). User interaction can take the form of gossip and norms i.e. this is the way we do things here. User interaction allows for knowledge to be shared within the enterprise on an informal basis. Schein (2001) has stated that it is the basic assumptions of the organisation that define what the worker pays attention to, the meanings of different things, emotional reactions to situations, and the actions to take in various types of situations. IS supports the decision-making needs of the organisation. According to Turban *et al* (1999) the purpose of an IS is to provide solutions to problems within the organisation. However, according to Krackhardt & Hanson (1993), it is the informal networks of the organisation that are taken advantage of when unexpected problems arise within the organisation. Consequently to develop information systems without taking this form of interaction into account will undermine the development of the new IS. It is through interaction that people get a better understanding of how things are performed within the organisation.

2.5 Experiencing & Its Impact On ISD

This acquisition dimension of tacit knowledge is identified as accumulative knowledge, derived from experience (Roberts, 2000; Howells, 1996). This tacit know-how is gained from experiences through trial and error (Howells, 1996; Roberts, 2000) and therefore it cannot be learned from books. It is only through experience that the user will be able to decide on the best course of action to pursue. Polanyi states "[experiential knowledge] guides integration of clues to discoveries" (Polanyi, 1966, p2). In ISD the user and analyst try to identify the best course of action to follow based on successful past experiences or failures. Experiential knowledge is highly skilled and cannot be learned from reading user manuals or books (Baumard, 1999). It is from past experiences that the user will be able to identify the right choice of action to pursue in relation to the decision-making process that IS support. Therefore when investigating requirements for ISD the analyst must include this area of knowledge into the methodology being used for developing the information system.

2.6 Contextual Learning & Its Impact On ISD

Contextual learning is the knowledge that resides in individuals about how they perceive themselves in their society or organisational culture. It allows us to make sense of the world (Polanyi, 1962). It is transferred through informal local practices amongst co-workers and does not reside individually amongst workers but at an organisational level (Howells, 1996) – it is specific only to that particular organisation (Cohen & Levinthal, 1990). Contextual learning can be further divided into social and cultural learning.

In the literature **social learning** has been defined as an informal way of learning through direct contact with co-workers (Roberts, 2000; Howells, 1996). It is through a connection with society that humans develop common interests, traditions, and beliefs etc that govern their role and place in their environment. Social learning governs the assumptions users' make about themselves, others and their environment. It is from this that user's modify their theories-in-use, i.e. the theory that governs their actions. In the literature **cultural learning** has been defined as an informal learning of behaviours within the organisation through socialisation with workmates (Roberts, 2000; Baumard, 1999). This tacit knowledge form has been described as being critical knowledge that is firm specific (Cohen & Levinthal, 1990). It includes the language that is used, the customs and traditions that evolve, and the rituals the workers employ in a wide variety of situations (Schein, 1992).

Failure to identify the contextual learning dimension of tacit knowledge would clearly weaken IS Development, for ISD to be successful, how the workers view themselves, make sense of their society (Polanyi, 1962), and how they learn this knowledge must be identified within, for example the requirements phase of ISD (Checkland, 1999).

2.7 Showing-How & Its Impact On ISD

Showing-how has been described as learning by watching, learning by doing and learning by using (Grant & Gregory, 1997; Howells, 1996). This acquisition dimension allows tacit knowledge to be transferred through demonstration, imitation and practice (Roberts, 2000; Polanyi, 1961). Schön (1987; 1983) suggests that through observations and skilful execution of performances and the individual's reflection on what has taken place, a description of tacit knowledge required to carry out the task can be made. This then allows for the tacit knowledge to be transferred from one person to the next. But these descriptions or constructions are attempts to make explicit the "intelligence that begins by being tacit and spontaneous…descriptions are conjectures that need to be tested against observation of their originals…" (Schön, 1987, p25). By comparing their description with an original the individual will learn how to perform the task at hand. Therefore this area of tacit knowledge allows know-how that is inexpressible to be passed between workers through guided imitation of an action (Polanyi, 1961). It is through illustration, replication and practice that the show-how feature of tacit knowledge is made available to others. Therefore show-how is an important acquisition dimension of tacit knowledge that needs to be identified within ISD, by enabling people to learn how to use the new systems in innovative ways, perform old tasks effectively and so on. At present knowledge that can only be transmitted through this medium is being omitted from the development of IS.

In conclusion there are three characteristics and five acquisition dimensions of tacit knowledge that have been identified within the literature. It is apparent that these facets of tacit knowledge are not detached from each other. It is also visible that each impacts upon

ISD. Failure to include these tacit knowledge forms when developing an IS would result in a system that neglects to meet all the knowledge support requirements of the organisation. Furthermore not to meet all these needs suggests that ISD does not (or cannot in its present form) deliver satisfactory effective systems. However, this framework needs more empirical work in order to establish and refine it as a unified model of tacit knowledge for ISD, this is for future work. The next section gives a brief account of four current ISD methodologies and the extent to which each addresses the tacit knowledge characteristics and acquisition dimensions identified above.

3. OVERVIEW OF ISD METHODOLOGIES & THE EXTENT TO WHICH EACH ISD METHOD ADDRESSES TACIT KNOWLEDGE

This section provides a brief overview of the different systems analysis and design methodologies that were critiqued in relation to the characteristics and acquisition dimensions of tacit knowledge that were discussed earlier. All of these issues impact upon each methodology in different ways, resulting in information systems that do not adhere to all the users requirements. As mentioned previously, tacit knowledge plays a major role in the information processing and decision-making needs of the organisation. Therefore since computer-based IS are designed to support these organisational needs, tacit knowledge must be included in the ISD process. Each methodology was selected as representative of a particular type of ISD approach.

3.1 UML / UP

Larman (1998) states, object-orientated (OO) analysis and design emphasizes a problem domain and logical solution from the object's perspective. The OO modelling approach that this paper investigates is the Unified Modelling Language / Unified Process (UML / UP) approach. Although barely a methodology, UML / UP was chosen for review as it is widely used in industry for systems development. UP is a software development process that is component based and uses the UML modelling standard. UML is a language for specifying, visualizing and constructing the artefacts of software systems. Larman (1998) states, the requirements phase of an OO methodology defines requirements that are unambiguous. Tacit knowledge is ambiguous and elusive; therefore to capture systems requirements with this approach is to exclude the tacit knowledge inherent to the user. Also requirements are identified through various electronic and paper documents. These are all explicit forms of knowledge, where the systems analyst can readily identify unambiguous requirements. Therefore the *implicitness* of tacit knowledge is largely ignored. Avison & Fitzgerald (1995) state with this approach there is a problem of users not really knowing what they require the new system to do. The system functions of the OO method describe what the system is supposed to do (Larman, 1998). These functions once identified should be listed in logical interrelated groupings. However the soft knowledge that is user-embedded is not taken into account, and the p*ersonal* knowledge of the user is omitted within this approach. With most ISD methodologies developers do not initially understand the current system and its environment. To overcome this, the system's users assist in the requirements capture for the new system. Bruegge & Dutoit (2000), state since the environment is dynamic, developers using this approach should encapsulate all assumptions they make about the environment at this stage. However, tacit

knowledge is difficult to define and quantify; all assumptions about the environment cannot be described with use cases. Therefore the *non-measurability* of tacit knowledge is not taken into consideration.

Bruegge & Dutoit (2000) state the requirements phase describes the system and its interaction with the environment, including users, work processes and other systems. However, the literature (Paech, 1998, Bruegge & Dutoit, 2000) listed four levels of description for requirements elicitation and none identify the importance of the interaction between users in transferring knowledge. The *interacting* dimension of tacit knowledge is not considered within this ISD approach. The system model is developed from the user's perception of reality (Bruegge & Dutoit, 2000). UML / UP does not take into account the experiential knowledge of the user in any explicit way. It identifies users, scenarios, use cases, relationships between use cases and non-functional requirements, nowhere does it incorporate techniques for exploring the experiences gained from prior successes or failures in working with IT. Explicit requirements are incorporated without a deep understanding of the experiences behind these requirements. Therefore *experiential* know-how is not identified in the requirements phase of this approach. This method identifies how systems developers view users, and from this develop detailed and concrete models that the future system will support. The developer thus may get a deeper understanding of how the user interacts with the current system, but neither social or cultural learning, which impacts upon both the ISD process and the effectiveness of the system after implementation is considered. The users' *contextual* learning, whether cultural or social, is omitted from this approach. The scenario in which the user operates is identified within the analysis and design stage of ISD, and these scenarios are concrete, focused, descriptions of a system feature. Showing-how involves the transfer of certain knowledge types through observation, imitation and practice. This formally inexpressible knowledge type cannot be described as a system scenario. Therefore UML / UP does not allow for the tacit knowledge dimension *showing-how* to be included within ISD. In summary, UML / UP fails to address in any coherent or comprehensive way, any of the major characteristics or dimensions of tacit knowledge as set out earlier in this paper.

3.2 SSADM

SSADM stands for Structured Systems Analysis & Design Methodology and is a data-driven methodology that places great emphasis on data modelling and the database. This methodology was chosen for review here, as it is one of the most widely used structured systems methodology. Avison & Fitzgerald (1995) identify the following major steps in SSADM: Feasibility Study, Requirements Analysis, Requirements Specification, Logical System Specification, and Physical design. SSADM is a highly structured methodology and it provides very detailed rules and guidelines for project development staff. SSADM investigates requirements through a number of different fact finding techniques (Avison & Shah, 1997; Goodland & Slater, 1995) that include interviewing people, studying existing documentation and problems, and analysing questionnaire responses. However, although the requirements may be expressed in narrative form, the analyst using SSADM expresses these in an independent implementation form, which will create a 'logical' requirements statement (Goodland & Slater, 1995). From this it can be deduced that only explicit data is given thought to with this ISD approach, since tacit knowledge cannot be easily expressed, therefore SSADM does not take into account the *implicitness* of tacit knowledge. The *personal* characteristic of tacit knowledge consists of intuition and hunches, but SSADM

only considers the facts and information that can be articulated by the current users of the system. This explicit knowledge is gathered through the performing of interviews, by analysing system documentation, and responses to questionnaires (Avison & Shah, 1997). This tacit knowledge dimension is not considered by SSADM. SSADM defines requirements that can be expressed in a "quantifiable and measurable way so that they can be tested" when the system is delivered to the user (Goodland & Slater, 1995, p77). With this approach the analyst uses questionnaires to identify user requirements (Avison & Shah, 1997). However, tacit knowledge is non-quantitative and resists codification and therefore this type of knowledge cannot be gathered by statistical measures. *Non-measurable* knowledge is not considered within SSADM.

In SSADM the majority of requirements are identified through one-to-one discussions between the users and the analyst. Avison & Shah (1997) state interviews allow for a detailed description of specific aspects of the situation under investigation, which provides an in-depth understanding of any business area under review. SSADM identifies requirements that can be measured and tested before implementation (Goodland & Slater, 1995). How the user interacts with his co-worker and fellow users to allow knowledge to be transferred is not considered. Therefore the *interacting* acquisition dimension of tacit knowledge is omitted. SSADM investigates current processing and data in the requirements analysis phase but fails to incorporate the knowledge gleaned from past experiences. Therefore the *experiential* know-how of the user is another dimension of tacit knowledge that is not considered in this methodology. The analyst is concerned with the *facts* about the organisation or the organisational section that is of concern within the ISD project (Avison & Shah, 1997). This includes when the information is required, and by whom, what it consists of, its purpose, and the activities that create and produce the data. The knowledge that the users have in relation to the social and cultural *context* in which they operate is not considered. Within the SSADM methodology, the analyst examines existing literature and documentation that might relate to the area under investigation. Only explicit data is considered, so the *showing-how* acquisition dimension of tacit knowledge is overlooked. In summary, like UML/UP, SSADM largely ignores tacit knowledge.

3.3 Soft Systems Methodology (SSM)

Soft Systems Methodology (SSM) was developed as an approach to tackling the messy problems managers have to deal with (Checkland & Holwell, 1993). The aim of this methodology is to create a learning cycle, which would result in an improvement in social concern within the organisation (von Bulow, 1989). In 1990 Checkland revised the SSM 7 Stage Model and presented the four-activities model of SSM. The four activities model begins with defining the problem including culturally and politically and ends with taking action in the situation to bring about improvement. Checkland (1981) states that unstructured problems should not be put into an explicit format but that they should be handled without a firm description; unstructured problems should be alleviated rather than solved. The 'comparison stage' of SSM allows problems that are ambiguous and cannot be clearly articulated be debated about and explored until a solution reveals itself. Implicit problems may be alleviated within this methodology, but the tacit requirements of the user are not identified. Therefore the *implicitness* of tacit knowledge is not fully taken into account within the SSM methodology. SSM does allow for debate and discussion between the system's stakeholders, but it does not explicitly identify the personal knowledge held

by the current systems users. Therefore the *personal* characteristic of tacit knowledge is not considered comprehensively within SSM. Checkland (1981) states the systems approach is a part of the scientific tradition and it takes the assumption that the world contains structured wholes, which can maintain their identity under different conditions. Tacit knowledge, does not maintain its structure, as it is dynamic and ambiguous. Consequently, the *non-measurability* characteristic of tacit knowledge is not taken into account within SSM.

The *interacting* dimension is included to some extent within the SSM methodology, through the approaches it recommends for involving users. It is from this that the analyst can view the interaction between users that allows for the transfer of tacit knowledge. Avison & Fitzgerald (1995) maintain, within SSM organisational change results in a learning process when theory and practice meet and affect each other. This is important for the transferral of tacit requirements, as tacit knowledge is included in the expertise and performance of the user. This analysis of past experiences is carried out in the comparison of root definitions of the relevant system with the conceptual model. This stage provides the systems developer with the means to reconstruct the past sequence of events and compare them with what had happened post-implementation, which is carried out through debate and discussion. From this it can be deduced that the *experiential* dimension of tacit knowledge is considered within SSM. An observed social system consists of logical congregations of linked activities and relationships, such as those of a community (Checkland, 1981). However, with the four-activities model (Mode 2) the cultural stream of analysis is implied in stage 1 of the model, i.e. defining the problem situation (Checkland, 1999). From this it can be concluded that the *contextual learning* dimension of tacit knowledge is considered implicitly to some degree within SSM. The analyst conducting the requirements investigation becomes a participant in the relevant user group; within SSM the roles of the subject and the researcher can be switched (Checkland, 1981). This allows the researcher to become the practitioner and to understand the process of change. This is relevant to finding certain tacit requirements of the user (s), especially tacit knowledge forms that are expressed and conveyed through show-how. However, these requirements that are needed to develop the system are not built upon, they are only identified so as to allow the users to become researchers, so that they themselves may get a better understanding of the processes in place. Therefore, s*howing-how* is considered to some degree within SSM. This methodology considers the experiencing dimension of the user; and it also takes into account to varying degrees the other seven issues. However, tacit knowledge is not explicitly looked at within this method. In conclusion, Checkland's SSM Methodology considers all of the characteristics and dimensions of tacit knowledge to some degree.

3.4 ETHICS

From her work at the Tavistock Institute, Mumford developed a socio-technical approach called ETHICS, which is an acronym for Effective Technical & Human Implementation of Computer-based Systems. ETHICS consists of 6 stages, which start with a diagnosis of needs and conclude with reports for the company, which describe the theory and practice of the research undertaken (Mumford, 2000a). Mumford also developed QUICKethics as a method for requirements analysis for managers. QUICKethics provides a method for identifying the implicitness of tacit knowledge at top-level management – information requirements of managers are identified through face-to-

face interviews and discussions, followed by group meetings. "Cross-validation of different archives can lead to the first inkling that there is something non-expressed [tacit] in an organisation's history" (Baumard, 1999, p90). It is through user debate and discussion that the *implicit* dimension of tacit knowledge can be identified and explored with this approach. According to Mumford (2000a) personal information is collected through individual face-to-face interviews and discussions with managers, followed by group meetings to identify priority management information needs. QUICKethics identifies management needs through 4 steps, which allows managers to self-reflect on their needs, provides an opportunity for self-identification and encourages group discussions and decisions. Therefore the *personal* aspect of tacit knowledge is an explicit requirement of the ETHICS methodology. This approach identifies system requirements through debate and discussion, and participation between the user and analyst. However tacit knowledge cannot be recorded or measured and escapes observation (Baumard, 1999). Therefore *non-measurability* is not considered in the ETHICS method.

According to Mumford (2001), people at any level in an organisation can play a major role in the development of successful work systems. Mumford (1993) states that instead of just being the system 'designer', the system analyst also takes on the tasks of being teacher, advisor and learner. By participating with the users in the design of the new system the analyst can identify the user interaction that enables tacit knowledge to be transferred. Therefore the *interaction* dimension of tacit knowledge is central within ETHICS. Mumford states that system users can design the system properly but will require training and help to do so. User involvement is essential to the ETHICS methodology as it is the users that have the skills of knowing about their own work and system, and have a stake in the design of the new system. Within ETHICS, Mumford recommends task variety, which involves giving a user one or more tasks to perform or by rotating several different people around a number of different tasks. This recycling of knowledge-workers may lead to the removal of tacit competencies for a particular process, although over time a level of cross-skills will develop. This approach, rather than focussing on the importance of deep *experiential* knowledge could be based on developing people who are 'jacks of all trades' but 'master of none'. ETHICS is a socio-technical approach in that it gives equal credence to social and technical issues. Within this methodology the context is identified through user participation, which is considered an important feature of the design process (Mumford, 2000a). The *contextual learning* dimension of the user is considered to some degree within this approach. As stated previously the designer's role is not the traditional role. The analyst together with the user develops the system. This participation on all sides allows for the relationship between users and the system to be highlighted. However nowhere in this approach is the *showing-how* dimension of tacit knowledge explicitly taken into account. This methodology considers the interaction between users. The other dimensions of the tacit knowledge framework are included to some degree, however not in great detail. Summarising, ETHICS addresses, to a greater or lesser degree, various characteristics and dimensions of tacit knowledge.

This section gave a broad overview of some of the current ISD methodologies that are covered by the literature and critiqued these methodologies in relation to the dimensions of tacit knowledge that were developed earlier. The next section summarises these findings in order to assess the extent to which major ISD approaches considers tacit forms of knowledge based upon a similar approach taken by Galliers (1992).

4. SUMMARY OF ANALYSIS

Figure 1 summarises the extent to which each methodology addresses various aspects of ISD. From Figure 1, the average totals of the hard methodologies averages at 1 meaning that these ISD approaches do not consider to any extent any form of tacit knowledge. The average totals for the soft approach to system design is 3, meaning that they are so-so in their identification of the characteristics and acquisition dimensions of tacit knowledge. The soft approach may not explicitly state tacit knowledge inclusion but tacit knowledge is indirectly included in the development of IS. Each tacit knowledge characteristic and acquisition dimension is given an overall average total in relation to the ISD methods analysed. The implicit and personal characteristics, and the contextual learning acquisition dimensions rate as 2, meaning that they are not considered within ISD. The experiencing and interacting dimensions of tacit knowledge are rated the highest with them averaging at 3, these acquisition dimensions are so-so in relation to ISD approaches – they are indirectly considered to some degree. The showing-how dimension and the non-measurable characteristic are the lowest ranking at 1, neither of these two forms of tacit knowledge are considered at all within ISD.

Figure 1: The ISD Methods Analysed in Relation to the Dimensions of Tacit Knowledge

TACIT KNOWLEDGE / ISD METHODS	CHARACTERISTICS			ACQUISITION DIMENSIONS					AVERAGE TOTALS
	IMPLICIT	NON-MEASURABLE	PERSONAL	EXPERIENCING	INTERACTING	SHOWING HOW	CONTEXTUAL LEARNING		
							SOCIAL	CULTURAL	
Object-Orientated (UML/UP)	1	1	1	1	1	1	1	1	1
SSADM	1	1	1	1	1	1	1	1	1
SSM	3	3	3	4	3	2	3	3	3
ETHICS	4	2	4	3	5	2	3	3	3
AVERAGE TOTALS	2	1	2	2	3	1	2	2	

1 Does definitely not include — 3 So so — 5 Considers comprehensively

Overall there is an apparent gap between ISD methodologies being used and tacit knowledge. Tacit knowledge is important for the successful development of an information system, as it identifies the rationality behind the decision being made by the user. Therefore since information systems support the process of decision-making, this area of knowledge needs to be included in ISD.

5. CONCLUSION

This paper set out to explore the extent to which current ISD approaches address tacit knowledge. From the literature, three characteristics and five acquisition dimensions of tacit knowledge were identified and the impact each has on the ISD process was highlighted. Next five current ISD approaches were critiqued in relation to the extent each addressed tacit knowledge. The result of this evaluation is that there are significant gaps in all ISD methodologies assessed, with soft systems approaches scoring significantly higher than hard systems approaches. ETHICS has the highest total for tacit knowledge inclusion. From the summary of analysis (Figure 1), it is evident that none of the ISD methodologies evaluated considers tacit knowledge important for IS development. The total averages for each characteristic and dimension individually is low, the lowest being the showing-how dimension and non-measurable characteristic, with the experiencing and interacting dimensions of tacit knowledge being the highest. From this it can be deduced that current IS technologies fail to take into account the tacit knowledge of the users. It is the user's tacit knowledge that enables an organisation to maintain its competitive advantage by enabling the user to generate better decisions. At present certain areas of knowledge have been omitted from consideration in current ISD approaches. The traditional view of ISD is that it creates information systems that support the decision-making and information processing needs of users. Tacit knowledge plays a large part in generating the decisions to be considered. This knowledge form is critical for ISD and should be taken into account for successful IS development and implementation. Therefore the tacit knowledge forms of the user needs to taken into account throughout the entire ISD process.

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