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Standardization through process documentation

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Abstract

Purpose – Consistency in operations is necessary for an organization's survival and growth. It is difficult to achieve consistency because of the employees' different ways of performing the same task. Employees' education, experience and skill levels determine their own styles and differences in their styles cause variations in process output. If process master's (best performers in a process) ways of performing their own tasks can be well documented, then a company will be able to standardize its operating procedures in their best forms. And, when employees follow these procedures, variations will be minimized and best quality products or services will be offered to customers. However, documenting such procedures is far from easy. The purpose of this paper is to propose a step-by-step framework on how to create process documents for standardization purposes.

Design/methodology/approach – Qualitative research was adopted for this study. Published works in the process improvement, knowledge management (KM), and project management literatures were used to build the proposed framework.

Findings – The roles of KM, semantics, and metadata schema were found very significant in creating process documents for standardization purposes.

Practical implications – Serves as a guide to practitioners who desire to standardize their operations.

Originality/value – A review of academic and business sources indicated that work on process standardization is conspicuously absent. This paper makes a contribution to fill this gap.

Keywords Standardization, Knowledge processes, Operations management, Document management, Semantics, Tacit knowledge

Paper type Research paper

Introduction

Producing goods and services on a consistent basis is crucial for businesses intoday's competitive environment, because consistent quality means repeated and more customers. This can be achieved through the standardization of a process. Standardization is defined as the degree to which work rules, policies, and operating procedures are formalized and followed (Jang and Lee, 1998). With standardization, the production or service process becomes routine with well-defined tasks. Today, many corporations with worldwide operations are interested in standardization of their processes. Because of the many benefits of standardized products and processes, national and international organizations for standardization were established (e.g. ISO). Companies in all over the world are spending significant amount of time and money to register with them to improve their operations and increase their business opportunities.

Although it may be claimed that standardization damages innovation, there are many benefits of it and these benefits are mainly from its power to provide consistent operations. Consistency increases efficiency. It also makes process control easier

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(Fitzsimmons and Fitzsimmons, 1994). Another benefit of consistency is to create a positive perception of service or product quality. An empirical study conducted by Hsieh *et al.* (2002) found that job standardization is positively related to the perception of service quality. This is because standardization will enable companies to minimize uncertainty and variability in their processes. Uncertainty and variability can be attributed to the differences in the ways people perform their tasks. Their skills, competencies, and behaviours determine their own performance. Then, the same task performed by different people gives different results. In order to reduce variations in the same tasks performed by different people, the best way of carrying out a process must be acquired and documented in detail. And also, the procedures in this document must be strictly followed. However, it must be pointed out that in most cases process documentation is very difficult as the level of detail increases. This can be explained by Polanyi's (1966) famous notion of "we know more than we can tell". According to this, individuals involved in a process develop their own way of doing things and are not able to easily communicate it. This is contributed to the tacitness of these persons' knowledge. The real challenge for the people who document a process is to get the tacit knowledge out of process participant's head and put it into written documents. Form the ideas presented so far, it clear that knowledge, KM, and process documents play key roles in standardization.

Despite its great attractiveness, academics' and practitioners' work on process standardization is conspicuously absent. This paper intends to make a contribution for a better understanding of standardization. For this purpose, first the roles of knowledge, knowledge management and process documentation are examined. Then, based on a literature review of KM, process improvement, and project management literatures, a framework on how to create process documents for standardization purposes was proposed. KM literature was reviewed because, all processes are carried out based on knowledge. Process improvement literature was reviewed, because standardization increases efficiency, reduces process variation, and enables easier process control. Hence, it is important for process improvement. And finally, some aspects of project management were found relevant, because knowledge from the past projects may be useful in creating process documents. Also, creating documents may itself be viewed as a project.

Process knowledge

As stated before, the knowledge of process masters must be acquired to create process documents. Because of this, it is important that people who document the process be knowledgeable about the types of the knowledge that they will acquire. Many types of knowledge are listed in the literature (e.g. procedural, causal, declarative, relational) (Alavi and Leidner, 2001). Of which, two should adequately cover the whole knowledge of a process: know-how (procedural knowledge) and information (descriptive knowledge). Know-how is the accumulated practical skill or expertise that allows one to do something smoothly or efficiently (Kogut and Zander, 1992). Know-how is a description of knowing how to do something (e.g. processes). On the other hand, knowledge as information implies what something means (Kogut and Zander, 1992). Kogut and Zander (1992) states that the information is contained in the original listing of the ingredients, but the know-how is only imperfectly represented in the description.

Making a pizza can be given as an example here. Ingredients for making a pizza represent information while recipe represents know how.

Either it is information or know-how; the nature of the knowledge determines the level of standardization. By nature, we mean the documentability of knowledge. The more knowledge is documentable the more likely it can be standardized. Documentability is an issue especially for know-how rather than information and closely related to the tacitness of knowledge. This is because information may also be tacit, its tacitness is not as much as know-how is tacitness. Teece (1998) observed that when the knowledge is highly tacit, the process will not be well understood. Polanyi (1962) argues that a large part of human knowledge is tacit. Empirically confirming this observation, Wah (1999), Bonner (2000) and Lee (2000) reported that 90 per cent of the knowledge in any organization is embedded and synthesized in people's heads (Smith, 2001). According to Lam (2000), this is particularly true of operational skills and know-how acquired through practical experience. This author also indicates that knowledge of this type is action oriented and has a personal quality that makes it difficult to formalize or communicate. Zack (1999) states that tacit knowledge is subconsciously understood and usually shared through highly interactive conversation, storytelling, and shared experience. In contrast, explicit knowledge is more precisely and formally articulated, although removed from the original context of creation or use (e.g. a mathematical formula or manual for describing how to assemble an equipment). This feature makes it stored in databases where it can be accessed and used easily by anyone in the company. Tacit knowledge can be split in two sectors: mental models, ideals, and emotions as cognitive tacit knowledge; and know-how to applicable to specific work as technical tacit knowledge (Alavi and Leidner, 2001). The first one is not articulable by nature and very effective to handle uncertain situations or unexpected problems in a process. On the contrary, the second one is articulable. Examples for articulable tacit knowledge include know-how, process, practice, practical know-how, and business knowledge (Busch *et al.*, 2001). According to this view, tacit process knowledge can be explicated and documented. In turn, this means that processes with identical inputs, outputs, and operations can be standardized.

Knowledge management

KM has attracted the interest of academics and practitioners and become a buzzword in the popular press in recent times as knowledge is claimed to be the most important asset of today's organizations. KM entails all of those processes associated with the identification, sharing, and creation of knowledge (Rowley, 2000). Two major strategies can be followed to manage the process knowledge: personalization (process oriented) and codification (product or artefact oriented) (Mentzas *et al.*, 2001). According to the codification strategy, knowledge is extracted from the person who owns it and stored in artefacts. A knowledge artefact is an object that represents knowledge. Some examples of knowledge artefacts include video training tapes, books, memos, business plans in print, and manuals (Holsapple and Joshi, 2002). On the other hand, the personalization approach does not make a distinction between the knowledge and the knowledge provider. It recognizes the tacit dimension of knowledge and assumes that knowledge is shared mainly through direct person-to-person contacts (Desouza *et al.*, 2002). This approach considers knowledge creation and sharing as a

continuous process between people and other process elements as well as tacit and explicit knowledge (Christensen and Bang, 2003).

The views above indicate that the artefact oriented approach must be followed in standardization for two major reasons. First, standardization requires that the same operations will be followed exactly by many employees at disperse geographical locations. This is only possible by documenting the process. Training employees by the process master may not suitable, because the company may be employing a large number of people. Also, even if the employees are trained, they will forget what they learn after a while. Second, standardization requires that knowledge creation be a discrete process. Once knowledge is acquired and written down, it is frozen until it is subject to revision. In other words, new knowledge is not created as a result of the person-to-person and person-to-other process elements (e.g. machine) interaction as the process-oriented approach suggests. If a process is to be standardized, there must be no tolerance for new knowledge creation. Employees will be by the book while performing their tasks.

The role of KM in standardization is not limited to the strategy to be followed to manage process knowledge in an organization. Also, from the identification of its sources to its use, how the knowledge of a process should be managed in the context of standardization is important. Many frameworks have been developed, mostly by consultants, to manage the knowledge within organizations. For a review of these frameworks please refer to Rubenstein-Montano *et al.* (2001), Nissen *et al.* (2000) and Holsapple and Joshi (1999). Also-called life cycle models, these frameworks are basically very similar in regard to activities they include. A synthesis of these frameworks was done by Lytras *et al.* (2002a) for e-learning purposes. The synthesized model includes the following activities:

- relate-value;
- acquire;
- organize;
- enable reuse;
- transfer; and
- use.

Some of these activities play key roles in standardization and will be mentioned as the framework for standardization is developed.

Process documentation

Since, process documents must be created to standardize a process, they should be well understood. The following paragraphs provide a review of process documents in the context of standardization.

A process is defined by American Production and Inventory Control Society (1995) (APICS), as "a planned series of actions or operations (e.g. mechanical, electrical, chemical, inspection, tests) that advance a material or procedure from one stage of completion to another." Process documentation is a graphical representation of a process. A process document must show clearly the relations between the activities, personnel, information, and the objectives in a given workflow (Colquhoun *et al.*, 1996). Process documents were first utilized in manufacturing companies. Later, it was

widely used in all kinds of organizations. Please note that process flowcharting, process mapping, and process documents are used interchangeably in this paper.

Process documents are mostly known for their great help in detecting problems in a given process. They are also important tools to standardize a process. Rago (1994) argues that, with a deployment flow chart, service delivery processes can be standardized. Bae (1993) asserts that process documentation is helpful for a company to achieve its smallest possible variation in production. McDonald's company sets a good example for this. It achieved a minimum level of variation by well documenting its burger making procedures (Zack, 1999).

Before mapping out a process, an appropriate level of detail must be determined. The appropriate level of detail depends on the objective of the documentation. As Janzen (1991) indicates when mapping is performed, there is no "magic level" of detail and the objectives of the people who map the process determine the level of detail. According to Symons and Jacobs (1997), detailed process mapping is required to achieve standardization and, thus minimize variation. To prepare it, the knowledge of the process masters must be acquired at the finest level of detail. This knowledge includes the sequence of the steps in a process, a precise description of job performed in each step (how exactly the job is performed), the specifications of the inputs, the outputs, and all decisions made in the execution of each step. The details make the difference in the process output. If a process is not documented in detail, employees will then develop their own ways of doing things because of the interpretation differences. And, this will cause a variation in the output.

Proposed framework

As indicated before, a detailed process map must be created for standardization purposes. To create such a map, this paper proposes a framework (Figure 1). In developing this framework, qualitative research was adopted. This research technique includes interviews, observational techniques, published and unpublished documents, company reports, memos, faxes, newspaper articles, etc. The simplest form of qualitative research is the use of published material (e.g. articles) (Myers, 1997). As a start up work in the issue of standardisation, this paper utilises this research technique. In other words, the framework developed here is based on previously published material. In the following sections, a step-by-step procedure for creating a process document will be given.

Identify the process

Not all processes are suitable for standardization. Before attempting to create standard operating procedures, people who do the documentation job need to make sure that the process has identical inputs, outputs, and operations in each step (Lillrank and Liukko, 2004). For example, custom-tailoring process cannot be standardized. Each customer chooses different types of garment, is different in sizes, and demands different styles. On the other hand, standardization is possible if same type of garment, style, and size are used for a number of customers.

Identify the process master(s)

At this phase, the process masters are identified to articulate and codify their knowledge. This stage corresponds to relate-value phase of KM framework.

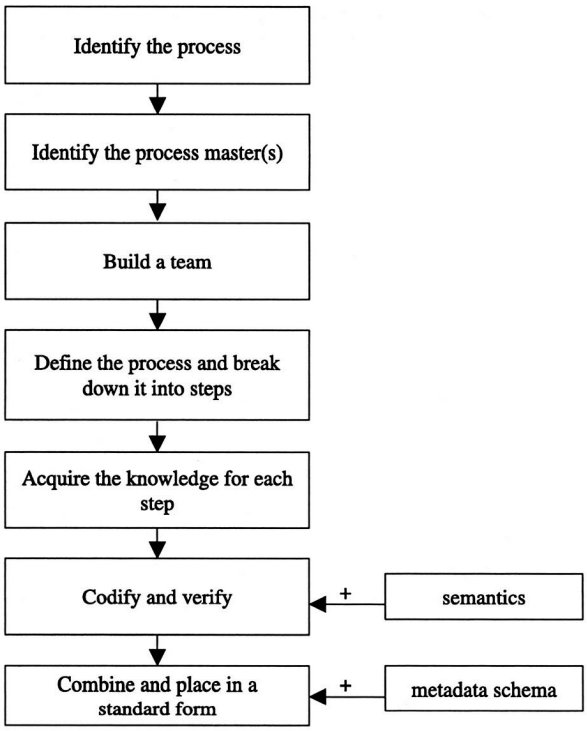

Figure 1.
Proposed framework for standardization

Relate-value stage of KM life cycle models aims to find and select the knowledge resources that provide knowledge with specific value components (Holsapple and Joshi, 2002). A process master as a knowledge source is the one who knows the best way of carrying out a task. In some cases, there is only one person in a company who can perform a specific task. This person is the process master then. This person is usually a well-known individual in a company. Published or unpublished documents (e.g. past project reports) may also be used to identify process masters. Whether a process master would be willing to release his/her knowledge is an arguable issue. In this paper, it is assumed that this individual fully cooperates to release his/her way of carrying out the process.

Build a team

The question of whether a team or an interviewer will be used to acquire the knowledge of process master may come to mind. Nesbitt (1993) states that two basic techniques are used for collecting flowchart data: interviewing and team or "group" method. This author suggests that interviewing be preferred when the process is uncomplicated and involves few participants. According to Nesbitt (1993) using the group method for complex processes makes it easy to achieve group consensus, incorporate different opinions, and solve problems. We argue that even if the process is not complicated, it is better to use a team to convert the tacit knowledge into the explicit knowledge, because tacit knowledge is action oriented and acquisition of it

requires sharing of experience. Using a team will be more effective to acquire tacit knowledge since a group of people will create a synergy in getting the process master to articulate his/her own perspective. This team should be formed of people performing same task as the process master does and persons who have a great deal of familiarity of the process. These team members are most likely to possess an ability to conduct a meaningful dialog. If the knowledge is procedural and explicit, having people in the team without experience with the process is not likely to be a problem, because they will not be required to interpret the knowledge. On the contrary, if the knowledge is tacit, the same team members will not be able to have a successful communication with the process master and among themselves.

Define the process and break down it into steps

At this stage, the process is defined and its intended purpose is clearly spelled out. The team determines the boundaries of the process. Then, it breaks down it into steps. The list of inputs, customers, suppliers, outputs, and tasks are identified for each step.

Acquire the knowledge for each step

Knowledge acquisition is one of the steps of KM life cycle frameworks and also termed as knowledge capture, knowledge representation, and knowledge extraction. According to Nissen (1999), it is about extracting knowledge from its sources. This knowledge might be in both explicit and tacit form. Acquisition of explicit knowledge is straightforward process. Some of the process master's knowledge might be in the written form. Even not, the process master will tell how he or she performs to the team as much as he/she can articulate. On the other hand, extracting tacit knowledge has been long known as a challenging task. In order to convert tacit knowledge into explicit knowledge, trust between knowledge provider and the knowledge seekers must be ensured. Knowledge provider should not be reluctant to share his/her knowledge (Clarke and Rollo, 2001; Nonaka, 1994). This is a prerequisite for effective knowledge sharing.

Articulating tacit knowledge into explicit concepts is called externalisation (Nonaka, 1994). Authors share the idea that tacit knowledge can be shared through communication and close interaction between individuals (Nonaka, 1994; Lam, 2000; Teece, 1998). Sternberg (1994) clearly explains that tacit knowledge is typically acquired on the job or in the situation where it is used. According to these views above, it can be concluded that to acquire the process master's knowledge, the team members must accompany this person on the job. As the process master progresses on the job, the team members communicate with this employee to understand how he or she performs the job and try to articulate and conceptualise his or her actions. During the sharing of experience, the team members and the process master help each other to articulate their knowledge and interpretation errors can be immediately corrected by a use of feedback. Nonaka (1994) suggests that a meaningful dialogue should be created for externalisation. Shared mental models, metaphors, and current and archived artefacts are important to create and sustain a meaningful dialogue. As the dialogue, goes on, the process master's actions are articulated. When there is an agreement among the team members regarding the articulated action, it must also be verified by the process master. If the process master verifies it, the process of conversion is achieved. If not, the dialogue between process master and team continues until both the team members agree among themselves and process master verifies the finalized articulated action. As stated above,

shared mental models, metaphors and analogy, and current and archived artefacts are important factors in creating a dialogue. And, they will be scrutinized in the following sub-sections (Figure 2).

Shared mental models

Shared mental models make the process of externalization easier. They involve both commonly agreed language and vocabulary and organizational memory (Madhavan and Grover, 1998). It is imperative that team members and process master speak the same process language (Nonaka, 1994). Therefore, a commonly agreed language (verbal and non-verbal clues) and vocabulary needs to be used by team members to convert tacit knowledge into explicit one (Kogut and Zander, 1992; Zack, 1999; Desouza *et al.*, 2002; Davies and Mabin, 2001; Madhavan and Grover, 1998), because this language helps team members to understand each other better, and thus to create a meaningful dialogue. This common language is developed when team members have similar ways of working, same values, and attitudes. Besides common language and vocabulary, common memory base of organizational experiences impacts the process of externalization. Organizational memory is stored information from an organization's history (Walsh and Ungson, 1991). According to this, team members with intense experiences in an organization will understand each other better and help each other to articulate their own perspectives, because they have the same or similar experiences in their memories.

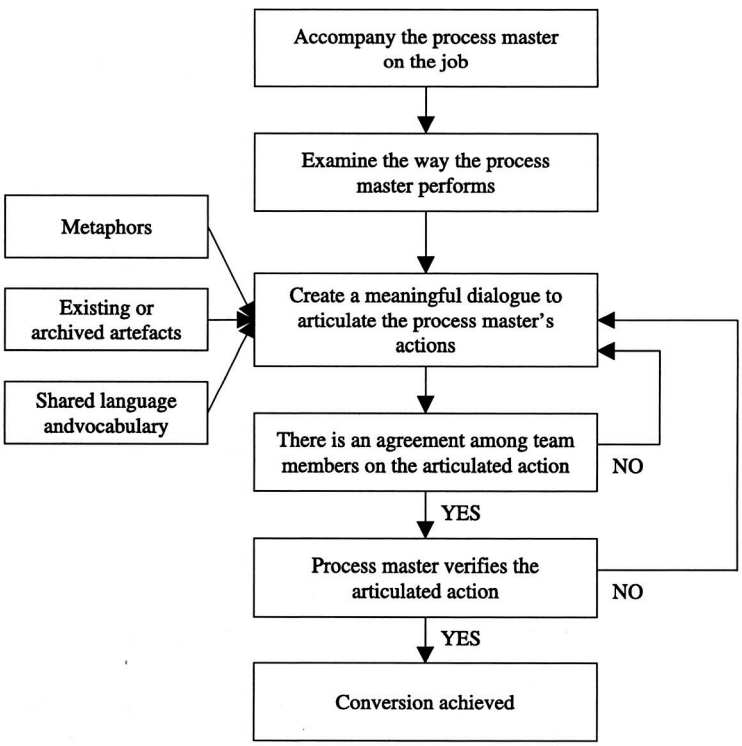

Figure 2.
Conversion of tacit knowledge into explicit knowledge

Metaphors and analogy

Use of metaphors and analogy in extracting tacit knowledge is suggested by Nonaka (1994). Metaphor can be described as figure of speech in which an expression is used to refer to something that it does not literally denote in order to suggest a similarity. On the other hand analogy is an inference that if things agree in some respects they probably agree in others. Contradictions incorporated in metaphor may be harmonized through the use of analogies (Nonaka, 1994). According to Nonaka (1994), metaphor and analogy are often confused. This author states that "the association of meanings through metaphor is mostly driven by intuition and involves images." On the other hand, the association of meanings through analogy is more structural/functional and is carried out through rational thinking. As such, metaphors provide much room for free association (discontinuity) (Nonaka, 1994, p. 21). And, analogy helps us to understand the unknown through the known and bridges the gap between an image and a logical model (Lauer, 2001). According to Lauer (2001) and (Frey, 2001), the role of metaphor and analogy is more powerful in capturing the knowledge than plain words. Examples for metaphors includes "time is money" or "product family". In transferring knowledge from one person to another, metaphors in the form of images may also be used. These images are called visual metaphors. Use of animal pictures to show the past present and the future of the company may be given as an example for visual metaphors (Dumas and Fentem, 1998). Some examples for analogies are "human brain operates the way a computer operates" or "an aircraft flies like a bird". Since, understanding and use of analogy is relatively easy, the following paragraph focus on how metaphors can be employed in converting tacit knowledge into explicit knowledge.

Both knowledge providers and the knowledge seekers use metaphors to get their messages across. Since, the procedural aspect of process knowledge makes it difficult to communicate through words, use of metaphors may enable process master to articulate his/her way of doing work. They help to convert vague and abstract ideas into concrete ones (Sackmann, 1989). As Srivastava and Barrett (1988) point out, metaphors are especially useful in transferring complex ambiguous experience. This may be attributed to their non-discrete nature. This feature allows users to think in many different ways. Because of this, they may be very helpful in explaining the procedures which embed tacit skills.

Current and archived artefacts

Current and archived artefacts (e.g. any process maps used prior documentation) help team members to create a meaningful dialogue (Nonaka, 1994). They enrich their explicit knowledge base of the process, and thus will improve their communication with the process master (Holsapple and Joshi, 1999).

Codify and verify

This phase of the framework is not really distinct from the previous one. As knowledge is acquired, it must be written down. And, only the team members should develop process maps. As Rohleder and Silver (1997) states, flow diagrams developed by non-team members have created confusion and general lack of agreement among team members. It is very important to note that process documentation is an iterative process (Savory and Olson, 2001). As Biazzo (2000) points out, step-by-step revision of the model is needed in developing the desired chart. The team members must continue

to work on a detailed process model until they receive a model with concrete and mutually agreed descriptions. As the team mutually agrees on the concepts, it puts them down on a paper in their own form, using their own words. In the final form of mapping, both process master and the team members should conceptualise the process the same way.

The standardization requires that the meaning of messages in the document be clear to any employee since these messages will be used by many employees at different locations. In other words, reusability of the process depends on if it can be well understood by the users. Probably, the most important issue in codifying standard operating procedures is to eliminate or minimize interpretation differences or, in other words, semantic ambiguity. Semantic ambiguity arises because some words may have certain meanings in a given context (Reimers, 2001). It is also possible that different words may denote the same thing at different locations of a company. This issue is even more problematic when a company has international operations. Description of all the important elements to adequately describe the process and its operation is necessary to eliminate interpretation differences (DiMarco and Hirstt, 1993). A dictionary may be attached to the process document for this purpose.

Combine and place in a standard form

Once documents are created for each step, they are combined to create a single process document. This document is checked for inconsistencies by the people who joined the documentation procedure. Then, the knowledge in it is organized in a standard form as also mentioned in KM frameworks. By doing so, authorized personnel can access the process by using its one or more attributes (e.g. process name). As Lytras *et al.* (2002b) indicates, the organization of knowledge in distinct objects, small structural components (e.g. list of inputs) is the basis of reuse. And, metadata schema can achieve this objective. Metadata is data about data. It describes the attributes and characteristics of the process. Data about the process can be gathered under the following areas:

- identity statement area;
- context area;
- content and structure area;
- conditions of access and use area;
- allied materials area; and
- notes area (Shepherd and West, 2003).

It is important to note that an entry in a metadata schema be linked to another metadata. For example, a process step in the metadata schema of a process may be linked to its sub-steps.

Utilizing a metadata schema is important in the context of standardization for two reasons. First, knowledge about the process is organized in a standard form. This will reduce the ambiguity when knowledge users use this knowledge. Second, a standardized process is intended to be used by many employees at many locations and metadata schemas will enable successful storage and access of this process.

There are more than 20 different types of international standard metadata schemas (El-Sherbini, 2001). The structures of these metadata schemas are about the same.

However, they differ in terms of complexity and design. Since, metadata schemas are application specific, one of those metadata schemas may be used or a new metadata schema may be created for standardization purposes (Choo, 2000). This issue is beyond the scope of this paper and quests an investigation.

Conclusion

Even if a process has identical, inputs, operations, and intends to produce identical outputs, its standardisation is far from easy. The ways different employees perform the same operation differently cause variations in the output. If the knowledge of the person who knows the best way of performing his/her task can be documented in detail and strictly adhered, then the variations in the process output will be minimised. This paper proposed a step-by-step framework for documenting a process. When developing this framework, few things were found to be important to mention. First of all, KM plays a crucial role in creating process documents. Especially, a successful conversion of tacit knowledge into explicit knowledge is crucial. Second, the role of semantics when codifying the knowledge is important. It is important, because standardized operations will be used by many employees at different locations. If the meanings of important words or concepts are attached to the documents, then employees will not have interpretation differences. In turn, they will not deviate from the target. Third, the process knowledge must be represented in a metadata schema for its successful organization, storage, and reuse.

As indicated before, this framework is based on published research. And, there is a need to test its viability. A future paper may be based on a case study testing the usability of this framework. A metadata schema for standardization purposes may also be proposed in a future work.

References

Alavi, M. and Leidner, D.E. (2001), "Knowledge management systems: conceptual foundations and research issues", *MIS Quarterly*, Vol. 25 No. 1, pp. 107-36.

American Production and Inventory Control Society (1995), *APICS Dictionary*, American Production and Inventory Control Society, Fall Church, VA.

Bae, H.M. (1993), "Process flow modeling and analysis: a practitioner's perspective", *Industrial Engineering*, June, pp. 54-5.

Biazzo, S. (2000), "Approaches to business process analysis", *Business Process Management*, Vol. 6 No. 2, pp. 99-112.

Bonner, D. (2000), "Knowledge: from theory to practice to golden opportunity", *American Society for Training & Development*, September-October, pp. 12-13.

Busch, P.A., Richards, D. and Dampney, C.N.G. (2001), "Visual mapping of articulable tacit knowledge", *Information Systems Frontiers*, Vol. 3 No. 1, pp. 41-8.

Choo, C.W. (2000), "Working with knowledge: how information professionals help organizations manage what they know", *Library Management*, Vol. 21 No. 8, pp. 395-403.

Christensen, K.S. and Bang, H.K. (2003), "Knowledge management in a project-oriented organization: three perspectives", *Journal of Knowledge Management*, Vol. 7 No. 3, pp. 116-28.

Clarke, T. and Rollo, C. (2001), "Corporate initiatives in knowledge management", *Education + Training*, Vol. 43 Nos 4/5, pp. 206-14.

Colquhoun, G.J., Baines, R.W. and Crossly, R. (1996), "A composite behavioral modeling approach for manufacturing enterprises", *International Journal of Computer Integrated Manufacturing*, Vol. 9 No. 6, pp. 463-75.

Davies, J. and Mabin, V.J. (2001), "Knowledge management and the framing of information: a contribution to OR = MS practice and pedagogy", *Journal of the Operational Research Society*, Vol. 52, pp. 856-72.

Desouza, K.C., Jayaraman, A. and Evaristo, J.R. (2002), "Management in non-collocated environments: a look at centralized vs distributed design approaches", *Proceedings of the 36th Hawaii International Conference on System Sciences*.

DiMarco, C. and Hirstt, G. (1993), "A computational theory of goal-directed style in syntax", *Association for Computational Linguistics*, Vol. 19 No. 3, pp. 451-99.

Dumas, A. and Fentem, A. (1998), "Totemics: new metaphor techniques to manage knowledge from discovery to storage and retrieval", *Technovation*, Vol. 18 Nos 8/9, pp. 513-21.

El-Sherbini, M. (2001), "Metadata and the future of cataloguing", *The Electronic Library*, Vol. 50 No. 1, pp. 16-27.

Fitzsimmons, J.A. and Fitzsimmons, M.J. (1994), *Service Management for Competitive Advantage*, McGraw-Hill, New York, NY.

Frey, R.S. (2001), "Knowledge management, proposal development, and small businesses", *Journal of Management Development*, Vol. 20 No. 1, pp. 38-54.

Holsapple, C.W. and Joshi, K.D. (1999), "Description and analysis of existing knowledge management frameworks", *Proceedings of the 32nd Hawaii International Conference on System Sciences*.

Holsapple, C.W. and Joshi, K.D. (2002), "Knowledge management: a threefold framework", *Information & Management*, Vol. 39, pp. 477-90.

Hsieh, A., Chou, C. and Chen, C. (2002), "Job standardization and service quality: a closer look at the application of total quality management to the public sector", *Total Quality Management*, Vol. 13 No. 7, pp. 899-912.

Jang, Y. and Lee, J. (1998), "Factors influencing the success of management consulting projects", *International Journal of Project Management*, Vol. 16 No. 2, pp. 67-72.

Janzen, M.W. (1991), "Total quality through process flowcharting", *AACE Transactions*, pp. F.8.1-F.8.4.

Kogut, B. and Zander, U. (1992), "Knowledge of the firm, combinative capabilities, and replication of technology", *Organization Science*, Vol. 3 No. 3, pp. 383-97.

Lam, A. (2000), "Tacit knowledge, organizational learning and societal institutions: an integrated framework", *Organization Studies*, Vol. 21, pp. 487-513.

Lauer, T.W. (2001), "Questions and information: contrasting metaphors", *Information Systems Frontiers*, Vol. 3 No. 1, pp. 41-8.

Lee, J. (2000), "Knowledge management: the intellectual revolution", *IIE Solutions*, October, pp. 34-7.

Lillrank, P. and Liukko, M. (2004), "Standard, routine and non-routine processes in health care", *International Journal of Health Care Quality Assurance*, Vol. 17 No. 1, pp. 39-46.

Lytras, M., Pouloudi, A. and Poulymenakou, A. (2002a), "Knowledge management convergence – expanding learning frontiers", *Journal of Knowledge Management*, Vol. 6 No. 1, pp. 40-51.

Lytras, M.D., Pouloudi, N. and Poulymenakou, A. (2002b), "Dynamic e-learning settings through advanced semantics. The value justification of a knowledge management oriented metadata schema", *International Journal on E-Learning*, Vol. 1 No. 4, pp. 49-61.

Madhavan, R. and Grover, R. (1998), "From embedded knowledge to embodied knowledge: new product development as knowledge management", *Journal of Marketing*, Vol. 62 No. 4, pp. 1-12.

Mentzas, G., Apostolou, D., Young, R. and Abecker, A. (2001), "Knowledge networking: a holistic solution for leveraging corporate knowledge", *Journal of Knowledge Management*, Vol. 5 No. 1, pp. 94-106.

Myers, M.D. (1997), "Qualitative research in information systems", *MIS Quarterly*, Vol. 22 No. 2, pp. 221-42.

Nesbitt, T.E. (1993), "Flowcharting business processes", *Quality*, March, pp. 34-8.

Nissen, M.E. (1999), "Knowledge-based knowledge management in the reengineering domain", *Decision Support Systems*, Vol. 27, pp. 47-65.

Nissen, M., Kamel, M. and Sengupta, K. (2000), "Integrated analysis and design of knowledge systems and processes", *Information Resources Management Journal*, Vol. 24.

Nonaka, I. (1994), "A dynamic theory of organizational knowledge creation", *Organization Science*, Vol. 5 No. 1, pp. 14-37.

Polanyi, M. (1966), *Personal Knowledge: Towards a Post-Critical Philosophy*, University Press, Chicago, IL.

Polanyi, M. (1966), *The Tacit Dimension*, Routledge & Kegan Paul, London.

Rago, W.V. (1994), "Adapting total quality management (TQM) to government: another point of view", *Public Administration Review*, Vol. 54, pp. 61-4.

Reimers, K. (2001), "Standardizing the new e-business platform: learning from the EDI experience", *Electronic Markets*, Vol. 11 No. 4, pp. 231-7.

Rohleder, T.R. and Silver, E.A. (1997), "A tutorial in business process improvement", *Journal of Operations Management*, Vol. 15, pp. 139-54.

Rowley, J. (2000), "Is higher education ready for knowledge management?", *The International Journal of Educational Management*, Vol. 14 No. 7, pp. 325-33.

Rubenstein-Montano, B., Liebowitz, J., Buchwalter, J., McCaw, D., Newman, B. and Rebeck, K. (2001), "A systems thinking framework for knowledge management", *Decision Support Systems*, Vol. 31, pp. 5-16.

Sackmann, S. (1989), "The role of metaphors in organization transformation", *Human Relations*, Vol. 42 No. 6, pp. 463-85.

Savory, P. and Olson, J. (2001), "Guidelines for using process mapping to aid improvement efforts", *Hospital Management Quarterly*, Vol. 22 No. 3, pp. 10-16.

Shepherd, E. and West, V. (2003), "Are ISO 15489-1:2001 and ISAD(G) compatible? Part 1", *Records Management Journal*, Vol. 13 No. 1, pp. 9-23.

Smith, E.A. (2001), "The role of tacit and explicit knowledge in the workplace", *Journal of Knowledge Management*, Vol. 5 No. 4, pp. 311-21.

Srivastava, S. and Barrett, F.J. (1988), "The transforming nature of metaphors in group development: a study in group theory", *Human Relations*, Vol. 41 No. 1, pp. 31-64.

Sternberg, R.J. (1994), "Tacit knowledge and job success", in Anderson, N. and Herriot, P. (Eds), *Assessment and Selection in Organizations: Methods and Practice for Recruitment and Appraisal*, John Wiley, London, pp. 27-39.

Symons, R.T. and Jacobs, A.R. (1997), "Multi-level process mapping: A tool for cross-functional quality analysis", *Production & Inventory Management Journal*, Fourth Quarter, pp. 71-6.

Teece, D.J. (1998), "Capturing value from knowledge assets: 'The new economy, markets for know-how, and intangible assets'", *California Management Review*, Vol. 40, pp. 55-79.

Wah, L. (1999), "Making knowledge stick", *Management Review*, May, pp. 24-9.

Walsh, J.P. and Ungson, G.R. (1991), "Organizational memory", *Academy of Management Review*, Vol. 16 No. 1, pp. 57-9.

Zack, M.H. (1999), "Managing codified knowledge", *Sloan Management Review*, Vol. 40, pp. 45-58.

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