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ABSTRACT

Knowledge management can be defined as a set of processes that includes knowledge creation, storage, dissemination, application, and measurement within the organization. As any other organizational process, knowledge management should be evaluated in order to verify if it is achieving the expected results. The aim of this paper is to relate metrics with the knowledge management process phases. Based on a bibliography research, this paper suggests metrics for knowledge management process phases such as creation (number of discussion groups concerning process innovation), storage (number of documents), dissemination (number of communities of practice), application (number of users that access the system), and measurement (number of evaluations). The knowledge management process phases do not follow a linear sequence. Measurement, for instance, is developed from the beginning to the end of the process.

Keywords

Knowledge management, process, metrics.

INTRODUCTION

In search for competitive advantages in comparison with competitors, several organizations are adopting initiatives in order to manage knowledge. Although this is not a recent concern, Davenport and Prusak (1998) point out that even before the time of the "organization that learns", the "essential competence", the "specialized systems", and the "strategy focus", worker's knowledge already had its value.

Knowledge management (KM) can be considered as a collection of processes that aim at creation, utilization and dissemination of knowledge in the organization (Teixeira; Silva; Lapa, 2004a). This collection must regard both explicit and tacit knowledge, hidden within the people's insights and experiences. Bontis, Dragonetti, Jacobsen and Roos (1999) emphasis that successful organizations are those that possess a more efficient management in their unattainable assets.

Davenport, Long and Beers (1998), in a study carried out with twenty-four companies, show that the implantation of knowledge management projects vary in cost, the type of knowledge which is involved, and coordination method. Nevertheless, four objectives were identified in these projects: the making of knowledge repositories, better access to knowledge, an improvement in the knowledge environment, and knowledge management as an asset. In 2004, Bose (2004) presented numbers that made it clear that many organizations are adhering to knowledge management programs. Around 80% of the companies mentioned in Fortune magazine have a staff assigned to KM activities. After the implantation of KM programs, Ford Motor Company saved U$ 914 million. About 95% of the CEO's that were questioned in Davos during the World Economy Forum asserted that KM is a critical factor in an organization's success. On the other hand, companies have implanted KM programs with no concern on its process evaluation and results (Ahmes; Lim; Zairi, 1999). This means that many organizations encounter difficulties to assert that the KM process is giving any result to the organization. Del-Rey-Camorro et al. (2003) justify this fact in part due to the difficulty to measure an unattainable asset as in the case of knowledge.

Organizations need to measure the KM process in order to verify if the desired results are being achieved. Bornemann and Sammer (2003) say that several KM approaches are available in literature. However, most of these approaches fail when it comes to measurement. Knowledge management needs to show that it aggregates value to the organization. This way the measurement becomes indispensable (Bose, 2004).

Considering the importance that knowledge management has in organizations, this paper aims to relate indicators to KM process phases. A bibliographical research took place to identify each phase and to map specific indicators to measure the process (process metrics) and to measure results (result metrics). This paper initially presents a discussion on the KM process

(section 2) and the utilization of metrics associated to the KM process (section 3). In the sequence follows final considerations referring to the relation between metrics and phases in the KM process (section 4).

KNOWLEDGE MANAGEMENT PROCESS

Darroch (2003) and Tiwana (2002) divide the KM process in three parts: acquisition, dissemination, and utilization of knowledge. The knowledge acquisition includes the development process and the making of insights and relations. Dissemination consists on sharing acquired knowledge. Utilization is regarded as the capacity of the organization in applying knowledge generated in new situations. Darroch (2003) tells that the organization may acquire knowledge through several sources, such as employees, customers, suppliers, and competitors, among others. The use of this acquired knowledge shows the organization's reply to new knowledge, that is, if the organization gained knowledge on the customer's demands, it will respond to this new knowledge by the adequateness of its products.

According to Armistead (1999), the KM process embraces the creation processes, transfer, and knowledge embedding. The author tells that the creation process requires mainly innovating individuals as a beginner. The way out should be the control of problem solution and the new generated knowledge. What is perceived is that since the knowledge creation stage there is the existence of evaluation metrics in the author's vision. The knowledge transfer process gives emphasis in the role of the individuals who facilitate the transference and the access to the created knowledge. The transfer process indicators support organizational efficiency through the best practices (Armistead, 1999). The objective of the process of embedding on knowledge is to guarantee that the created and transferred knowledge may be incorporated in the organization's processes. Although the author does not consider measurement as a KM process phase, the evaluation is present within the presented phases. The model works with measures since creation and transferences up to knowledge embedding.

Bose (2004) presents the stages of a cyclic process in knowledge management. The process proposed by Bose (2004) is composed by:

a) create knowledge – knowledge is created at the moment people discover new ways to do things. Employees in the organization can create knowledge or it can be transferred from research labs to the organization;

b) capture knowledge – after being built, the created knowledge must be stored in its primitive form;

c) refine knowledge – at this moment the tacit knowledge is contextualized and refined along with explicit knowledge;

d) store knowledge – the codification of tacit and explicit knowledge aids in the understanding of knowledge for later use;

e) manage knowledge – knowledge must be maintained updated, hence the organization has to make sure that knowledge is reviewed;

f) disseminate knowledge – knowledge must be available to all workers in the organization. Tools like groupware and internet/intranet aid this stage;

Ahmed et al. (1999) bring forth a sight in KM process related to the PDCA cycle (plan, do, check and act). The first stage is the knowledge creation, which represents the "plan" of the PDCA cycle. During this phase, the organization counts with external sources, structured internal sources, or non-structural internal sources of knowledge. The second phase, representing "do", is the knowledge sharing. In this stage the organization may use communication tools to share knowledge. The next stage associated with "check" is the measurement of the effects when the organization uses data from the other stages in order to measure the success of the activities. Learning and improvement correspond to "act" in the PDCA cycle. In this phase the organization uses the obtained results by measurement to continually improve the process.

Demarest (1997) proposes five phases for the KM process: construction, embodiment, dissemination, use, and management. Construction involves the creation of new knowledge through a complex process that can use translation and reinterpretation. The embodiment of knowledge consists in transforming knowledge created in processes, practice, material and culture within the organization. Dissemination is aimed to distribute transformed knowledge to all the members of the organization. The fourth stage, use, is the application of created knowledge, transformed and distributed through the anterior phases. Management consists in monitoring, measuring and interfering in the KM process phases.

Burk (1999) presents the cycle of knowledge through four stages: creation, organization, sharing, and utilization/reutilization. In the first stage knowledge is created or found by different means such as publications, conference, meetings, experiences, and research. The organization stage consists in filtering and cataloguing knowledge. In the sequence, the sharing stage means to make knowledge available through the organization's communication channels. Utilization and reutilization is the application of new knowledge on real problems. The author does not suggest a specific stage for refinement, yet he includes the activity to filter knowledge in the stage he refers to as organization.

Chen and Chen (2005) suggested four stages for the process from a bibliographical research on KM processes. The first is the knowledge creation, which is the newly added knowledge or the correction of already existent knowledge. The conversion in the second stage may be defined as the transformation in individual knowledge in organizational knowledge by contextualization. In the following stage occurs the knowledge circulation within an organization through the transference of knowledge among individuals and also groups. The last stage, called completion, is when the application of knowledge is transformed into competitive advantage.

Lee, Lee and Kang (2005) propose a process of knowledge circulation. The authors attribute five stages to this process: creation, accumulation, sharing, utilization, and internalization of knowledge. Creation is defined as a stage where individuals are interrelated in a new way to bring new knowledge. In the accumulation stage occurs storage of already created knowledge while the sharing stage promotes the diffusion of knowledge for the other individuals in the organization. Knowledge is applied in the utilization stage where are made the best practices. Internalization occurs after utilization when the individuals adopt the new knowledge in their daily life.

It is perceivable that all authors agree about the existence of knowledge creation phase. Storage is mentioned by Bose (2004), Burk (1999), Lee et al. (2005), Demarest (1997), whom point out the necessity to codify and catalogue knowledge during the KM process. Darroch (2003) and Armistead (1999) do not mention the storage of knowledge in the description of their processes. The other authors mention the utilization of repositories, but do not associate it to any process phase. The dissemination stage, also known as sharing, is common among all authors. This is an important stage in the process as it advertises new knowledge in the organization. Bose (2004) does not refer to utilization, however he does assert that dissemination must make knowledge available in a way that it may be used by anyone in the organization. As to management, only Bose (2004) and Demarest (1997) show the need to maintain knowledge updated. The necessity for measurement is presented by three authors: Armistead (1999), Demarest (1997), and Ahmed et al. (1999). Although Armistead (1999) does not clearly specify a phase for measurement, there is a presence of metrics in all stages. Demarest (1997) presents the management phase in which there is a measurement process while Ahmed et al. (1999) explicitly present a measurement phase on the effects of the process before it is incorporated.

It was possible to identify common stages as creation, dissemination and utilization of knowledge of the proposed analysis by the authors. Some authors mention other stages, such as storage and measuring effects, yet despite its importance it is uncommon in its definitions. In a way the authors follow the same route with more or less details. This paper proposes the stages of; **creation** – addition of new knowledge and settling of existent knowledge; **storage** – codification of knowledge for its storage in knowledge databases; **dissemination** – communication or distribution of knowledge within the organization; **utilization** – application of knowledge; **measurement** – evaluation of the KM process phases and results. Figure 1 compares the suggested phases by the authors and the proposal elaborated in this paper.

The KM process stages that were adopted in this research are creation, storage, dissemination, utilization, and measurement. The latter occurring parallel with the others. In the next section the focus is the measurement phase and its relation with the other stages through metrics.

KM PROCESS MEASUREMENT

This section presents a few measures models and characteristics (3.1) that may be used in order to aid in the identification of indicators (3.2) for the KM process.

Measures Models and Characteristics

Ahmed et al. (1999), Demarest (1997), Armistead (1999), and Teixeira et al. (2004a) emphasis the importance in measuring the KM process. "Knowledge management is a collection of processes that governs creation, dissemination, and the utilization of knowledge to achieve the objectives of an organization in which indicators are necessary as in any other organizational process (Teixeira et al., 2004a).

According to Bose (2004), knowledge management measurement is in its initial phase as managers did not yet associate knowledge management with the maximization of the organization's results. Ahmed et al. (1999) assert that there is a difficulty in measuring an evasive concept as knowledge. This forces managers to implant KM programs without the worry of evaluating the process.

Del-Rey-Camorro, Roy, Wegen and Steele (2003) say that the KM process is known by the organizations however its implantation is different from the proposed models out of theory. Barriers become perceivable once in practice that interfere in the organization's flux of knowledge. Failures in the dissemination of knowledge may occur that might compromise earlier

stages. Therefore, once adopting a KM process the organizations will also need to adopt measurement mechanisms of this process.
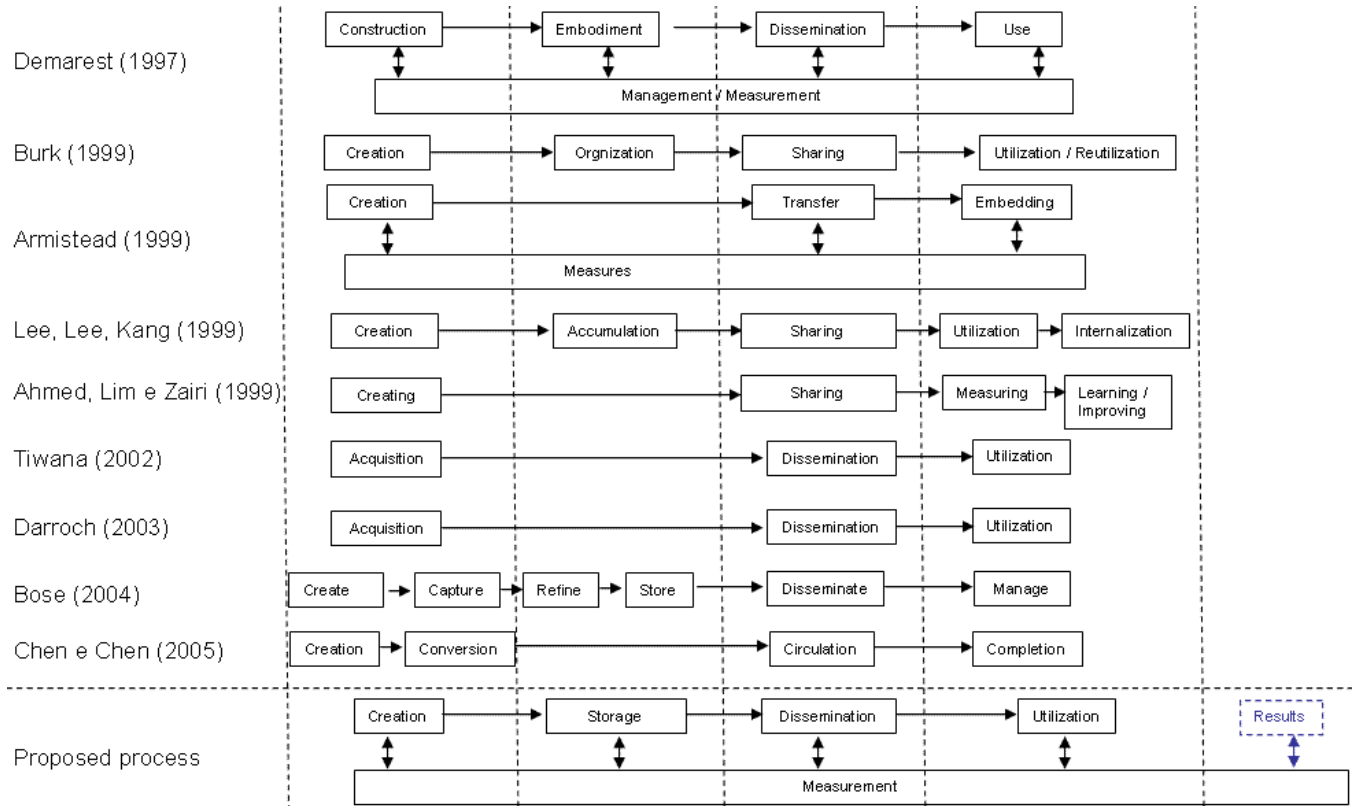

Figure 1 – Knowledge management process phases

The characteristics of a specific measurement system for KM proposed by Ahmed et al. (1999) are as follows: the performance must be measured in all organization levels, since the strategic level up to the operational level; performance measurement must consist in a combination of indicators towards individual tasks and process management tasks; indicators must show the areas where opportunity improvements in the organization exist. Ahmed et al. (1999) and Bose (2004) suggest that organizations link their specific KM measure systems with their performance measure systems, that is, to bind knowledge management with organizational performance.

Measurement models related to a KM process may be found in literature as, for example, in Balanced Scoreboard (Bose, 2004; Kaplan; Nortan, 1996; Teixeira; Silva; Pousa, 2004b; Skyrme; Amidon, 1998); Balanced Scorecard Framework (Del-Rey-Camorro et al., 2003) Skandia Navigator (Bose, 2004; Teixeira et al, 2004b; Skyrme; Amidon, 1998); Economic Value Added (Bontis et al, 1999; Bose, 2004); COST Model (Ahmed et al., 1999).

Independent to the adopted model, it is necessary to be careful while constructing a measurement system. Price Waterhouse (1997) tells that only a well-balanced indicator collection is capable to show the company's reality. There is no complete indicator that can be implanted on its own. A well-balanced collection must be formed by financial and non-financial performance indicators; costly and non-costly; internal and external; related to process and results (Price Waterhouse, 1997).

KM Evaluation Metrics

Metrics are used to aid managers to identify if their organizations are "better than yesterday and if they are better or worse, or doing just as well as their competitors are" (Moreira, 1996). In Price Waterhouse's view, the metrics register the progress to inform the workers what really matters and to support a reward system. Besides that, metrics are able to build-up the culture of the company once they influence organizational values.

Moreira (1996) presents qualities and characteristics on performance indicators. The first quality is trust that can be defined as the capacity of a measuring instrument that always attributes the same value to something invariable that is being measured. The second quality is effectiveness, which is the capacity of a measuring instrument to attribute the correct value,

which is to measure that which is to be measured. The metrics that involve monetary units are easy to be obtained, however it is possible to encounter effectiveness problems in non-monetary indicators, such as in performance level, innovation grades, decentralization grades, and others. This happens because indicators are not objective and there is no defined formula for each one's calculation. The third quality of a measurement is importance, which means that a measurement should contain useful information not found within other measurements. The organization should observe consistency with all measurements. The author reveals that organizations prefer many times to choose measurements that deteriorate the others. One example as an option is a customer attendance time indicator that might impair attendance quality.

Teixeira et al. (2004b) present some basic cares that must be considered in the selection of metrics:

a) avoid the excess of indicators;

b) use indicators which captivation is natural in the processes, that is, the indicators should be easy to collect;

c) communicate the aim of the indicator collection and what will be of the obtained results;

d) analyze time-indicator behavior;

e) communicate indicator analysis results.

The specific KM indicators can be divided in process indicators and result indicators. The process indicators, also known as lead or effort measures, propose to evidence organization initiatives as to the KM process. The result indicators, also known as lag measures, reflect operational or strategic objective achievements. However, process indicators *"do not obviously mean result, that is, knowledge management effectiveness. Result indicators do not depend only on knowledge management (there is also the macroeconomic situation, capacity of investment, etc.)"* (Teixeira et al., 2004b, p. 404). Hronec (1994) views that quality can only be attained by the equipoise of two types of indicators: the process performance measures and performance output measures. The measurement of the process performance monitors the activities in the process motivating the participants. These indicators are used in the resolution and prevision of problems. The performance output indicators reflect the result of a process. These measurements are reported to the high-leveled management that uses it to control the resources.

The indicators may also be qualitative and quantitative. Robertson (2003) tells that most of the time it becomes necessary to make use of qualitative indicators. Chen and Chen (2005) assert that qualitative indicators are associated with the need to measure behavioral aspects.

Besides quantitative and qualitative, focusing on the result and process, the indicators may be financial or non-financial. Chen and Chen (2005) regard that the financial indicators focus on investment income, in the present net value, in knowledge feedback, and more. It is perceivable that financial indicators are better placed when used as result indicators as they do not evaluate the process phases, but the final result. The non-financial indicators make use of frequency, time and quantity. These appear more adequate when used as process indicators as they can evaluate the KM process phases. Chen and Chen (2005) also place another classification for the indicators. They suggest that the indicators may be internal or external. Internal aims to measure the results and the process within an organization. External indicators are for external comparisons, benchmarking.

The following table relates process metrics that appear in literature with each KM process phase. The phases in use are those specified earlier (creation, storage, dissemination, utilization and measurement).

When it comes to the metrics in the creation phase it is perceivable that the proposed indicators by Teixeira et al. (2004b) are all quantitative as it aims to measure only a quantity of new knowledge created by the organization.

In order to measure the storage phase it is necessary to apply to the statistics of the system that stores the organizations knowledge. However, Robertson (2003) points out that these indicators should be used with care, as the availability of the systems must also be analyzed. The author suggests metrics that identify if the stored knowledge is valid, updated and of quality. The author also asserts that these are difficult indicators to put in practice as some involve the entire organization like user's feedback. In this case, for each knowledge, the system should request the readers to give a rate in order to classify knowledge. Some aspects may be regarded in a quantitative point of view (quantity of updates, for example) and qualitative (knowledge updating level).

It has been observed in the dissemination phase that the indicators proposed by Teixeira et al. (2004b) are mostly quantitative. It is suggested but one qualitative metric that aims to measure worker's perception as well as the organization's available means of communication. Armistead (1999) suggests that metrics in the dissemination phase should remain focused in trust, integrity, and accessibility. Besides that, the organization must measure the cost of knowledge distribution.

In the utilization phase the authors focus on the disseminated stored knowledge application with quantitative indicators.

	Process Metrics	Authors
Creation Phase	• Quantity of discussion groups on process or product innovation • Quantity of valid contributions for organizational memory /intranet	Teixeira et al. (2004b)
Storage Phase	• Quantity of messages or documents stored in the system • Number of registered users who use the system • Quality of stored knowledge • Experts evaluation to check quality • Quantity of editions or updates • Level of knowledge updating • User's feedback	Robertson (2003)
Dissemination Phase	• Quantity of active communities of practice • Statistics on use of organizational memory / intranet • Perception of collaborators with available internal means of communication	Teixeira et al. (2004b)
	• Cost of distribution	Armistead (1999)
Utilization Phase	• Quantity of useful suggestions incorporated to productive processes and/or products	Teixeira et al. (2004b)
	• Statistics of utilization of the system • Statistics of utilization of the search mechanism	Robertson (2003)
	• Number of ideas or patent	Armistead (1999)
Measurement Stage	• Comparison between number of measurement planned hours and actual hours • Number of evaluations made in comparison with the plan	Paulk, Weber, Curtis, Chrissis (1999)
All Stages	• Knowledge management performance index (KPMI)	Chen and Chen (2005) Lee et al. (2005)

Table 1 – Process Metrics

For the measurement phase it is possible to use metrics that verify if the process is being measured effectively. The software development area uses similar indicators that can adapt to this phase. Paulk et al (1999) suggest the elaboration of a plan with details on how evaluations are to be conducted. Thus, the indicators are based on comparison between what has been done with what was planned. The quantity of evaluations done compared to the planned is an example.

Another process metric brought up in literature (Chen; Chen, 2005; Lee et al., 2005) is the knowledge management performance index (KMPI). This indicator's calculation is based on the evaluation of each KM process phase. If the efficiency of the KM process has improved then it is reflected directly in the measure. This indicator cannot be associated with a specific phase as it aims to evaluate all KM process phases.

Regarding result metrics, Chen and Chen (2005) suggest financial measures as well as non-financial. The table below shows some metrics along with the authors who propose it use in KM.

The result metrics must be related with the business goals of each organization (Robertson, 2003). Financial indicators, as well as non-financial, can be used depending on the objectives that the organization intends to achieve with KM.

CONCLUSION

This paper began with the discussion on the search for sustainable competitive advantage followed by the vision of authors concerning process phases that may be used in KM. Several approaches were presented and compared from the attained results and a process was selected that contains the following phases of knowledge: creation, storage, dissemination, utilization, and measurement. A review on measure models commenced right after the review on KM processes. The

importance of measuring the process and some specific KM measure system characteristics were emphasized. By the comparison of methodologies it was possible to verify that some do not have available measurement mechanisms in the KM process phases, which means that they supply result metrics, not considering process metrics. After model analysis came the performance indicator analysis that can be used for KM measurement in organizations.

	Result Metrics	Authors
Non-financial	Improvement in employee's skills Improvement in strategy's quality Improvement in core business processes Development in customer relationship Development in supplier relationship Development in innovative culture Decrease of product cycle time Increase on operation productivity	Chen and Chen (2005)
	Average time to solve problems Grade of reduction of customer complaints on products & services Grade of reduction on rework	Teixeira et al. (2004b)
	Grade of individual learning Grade of organizational learning Evidence of best practice	Armistead (1999)
Financial	Reduction of operational costs Increase of market share Increase of shareholder's equity Increase of patent income	Chen and Chen (2005)
	EVA – Economic Value Added	Bontis et al (1999) Bose (2004)
	Earnings per share Growth rank in industry Total shareholder return	Buren (1999)

Table 2 – Result metrics

Although the models for the choice of evaluation indicators for KM processes were not the focus of this research, it is perceivable the necessity of investigations on this topic. The Skandia Navigator model and EVA have focus on results not contemplating the KM process evaluation phases. However, the Balanced Scorecard Framework and COST withhold process and result. One point to be regarded in the indicator selection model is the consideration on the alignment of KM process result indicators with the business goals of an organization.

The proposed knowledge management process in this paper comprises the creation, storage, dissemination, utilization, and measurement phases that should follow the process since the beginning by the use of process metrics and by result metrics at the end. Process metrics relate with the process phases as they intend to attest such effort. Besides this attendance throughout the process, measurement evaluates the results obtained by KM by the result metrics that must be aligned with the business goals of the organization. Therefore, as shown in figure 2, the measurement phase withholds process metrics (qualitative or quantitative) and result metrics (financial or non-financial).

According to Price Waterhouse (1997), it is necessary to build a collection of well-balanced indicators. This regards metrics that contemplate all the phases and the KM process results. By the bibliographical research it was possible to verify that process metrics can be either quantitative or qualitative. The result metrics should also equilibrate financial or non-financial indicators.

When using quantitative and financial indicators it is necessary to check on relevance. Moreira (1996) asserts that the measurement should bring some useful information besides being consistent with the other indicators. When it comes to using qualitative and non-financial indicators it is necessary to check on validity. According to the author it is possible to find validity problems on these indicators, once there is no defined formula for non-objective indicators. Trust is a quality that should be conferred to all indicators used on the measurement phase. A special attention is required with metrics that can obtain better rates that may be damaging other relevant aspects as, for example, the indicators that measure time because one of the manners to reduce time is by quality reduction, which certainly is not the objective of an organization.
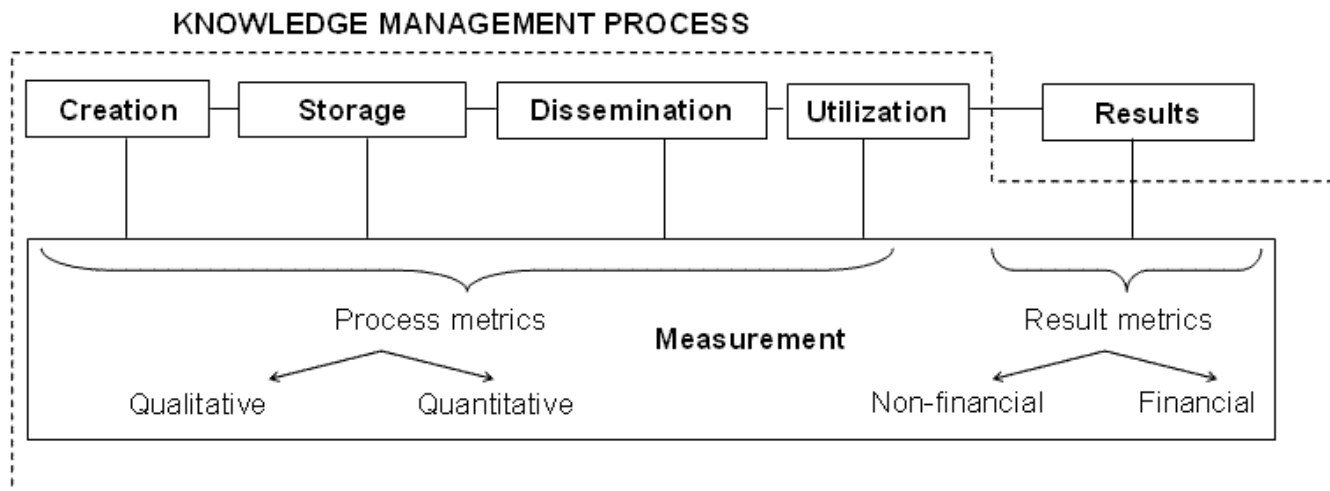
Figure 2 – KM process metrics

The identified metrics in literature were in a reduced number, being that each author presents their indicators that may be associated to different phases in the KM process or its results. This is evidently a topic for further investigation, as the organizations need instruments that permit to identify the KM process effectively. In the sequence to this research will be verified the perception of managers and users as to advantages and disadvantages of the adoption of each identified metric through this research as well as those used in the experiences.

ACKNOWLEDGMENTS

REFERENCES

1.   Ahmed, P.K.; Lim, K.K.; Zairi, M. (1999) Measurement practice for knowledge management. *Journal of Workspace Learning*: Employee Counselling Today, 11, 8, 304-311.

2.   Armistead, C. (1999) Knowledge management and process performance. *Journal of Knowledge Management*, 3, 2, 143-154.

3.   Bontis, N.; Dragonetti, N.C.; Jacobsen, K.; Roos, G. (1999) The knowledge toolbox: a review of the tools available to measure and manage intangible resources. *European Management Journal*, 17, 4, 391-402.

4.   Bornemann, M.; Sammer, M. (2003) Assessment methodology to prioritize knowledge management related activities to support organizational excellence. *Measuring Business Excellence*, 7, 2, 21-28.

5.   Bose, R. (2004) Knowledge management metrics. *Industrial Management & Data Systems*, 104, 6, 457-468.

6.   Buren, M. E. V. (1999) A yardstick for knowledge management. *Training and Development*, 53, 6, 71-78.

7.   Burk, M. (1999) Knowledge management: everyone benefits by sharing information. *Public Roads*, 63, 3, Available at: <http://www.tfhrc.gov/pubrds /novdec99/km.htm>. Accessed on: November, 2nd 2005.

8.   Chen, M.; Chen, A. (2005) Integrating option model and knowledge management performance measures: an empirical study. *Journal of Information Science*, 31, 5, 381-393.

9.   Darroch, J. (2003) Developing a measure of knowledge management behaviors and practices. *Journal of Knowledge Management*, 7, 5, 41-54.

10. Davenport, T.H.; Prusak, L. (1998) Conhecimento empresarial: como as organizações gerenciam o seu capital intelectual, Campus, Rio de Janeiro.

11. Davenport, T.; Long, D.W.D.; Beers, M.C. (1998) Successful knowledge management projects. *Sloan Management Review*, 39, 2, 43-57.

12. Del-Rey-Camorro, F.M.; Roy, R.; Wegen, B.V.; Steele, A. (2003) A framework to create key performance indicators for knowledge management solutions. Journal of Knowledge Management, 7, 2, 46-62.

13. Demarest, M. (1997) Understanding Knowledge Management. *Long Range Planning*, 30, 3, 374-384.

14. Hronec, S.M. (1994) Sinais Vitais, Makron Books, São Paulo.

15. Kaplan, R.S.; Norton, D.P. (1996) The balanced scorecard, Harvard Business School Press, Boston.

16. Lee, K. C.; Lee, S.; Kang, I.W. (2005) KMPI: measuring knowledge management performance. *Information and Management*, 42, 3, 469-482.

17. Moreira, D. A. (1996) Dimensões do desempenho em manufatura e serviços, Pioneira, São Paulo.

18. Paulk, M.C.; Weber, C.V.; Curtis, B.; Chrissis, M.B. (1999) The capability maturity model, Addison-Wesley, Massachusetts.

19. Price Waterhouse. (1997) Mudando para melhor: as melhores práticas para transformar sua empresa, Atlas, São Paulo.

20. Robertson, J. (2003) Metrics for knowledge management and content management. *KM Column,*. Available at: <http://www.steptwo.com.au>. Accessed on: August, 17th 2005.

21. Skyrme, D.L.; Amidon, D.M. (1998) New measures of success. *The Journal of Business Strategy*, 19, 1, 20-24.

22. Teixeira, J.; Silva, R.; Lapa, E. (2004a) Os prjectos de implantação. In: Silva, R.V.; Neves, A. (Org.) Gestão de empresas na era do conhecimento. Serinews, São Paulo, 443-473.

23. Teixeira, J.; Silva, R.; Pousa, M. (2004b) Os indicadores para avaliação da gestão do conhecimento. In: Silva, R.V.; Neves, A. (Org.) Gestão de empresas na era do conhecimento, Serinews, São Paulo, 401-432.

24. Tiwana, A. (2002) Knowledge management toolkit. Orchestrating IT, strategy, and knowledge platforms. Prentice Hall PTR, United States.