A Framework To Create Performance Indicators In Knowledge Management

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Abstract

Knowledge management (KM) is emerging as one of the most powerful management tools in today's manufacturing. It looks at the company resources in order to gain competitive advantage. The management of these resources can mean the difference between success and failure in a competitive environment. This encourages companies to look for better ways in the management of these intangible assets, developing KM projects in order to provide KM solutions to solve knowledge bottlenecks through Knowledge processes. However, if KM solutions are considered as an important part in today's businesses, they should be under the same controls as other management solutions, implying that Knowledge management solutions should be monitored as traditional solutions in order to assess the impact on the business objectives.

1 Introduction

Knowledge Management" is becoming a fashion word which people are becoming accustomed to listening to. If KM workers were asked for a definition for KM, a large list of them according to the role that the interviewee is developing in the KM domain would be obtained. In the concrete domain of performance measurement, KM is leveraging the intellectual assets of the company to meet defined business objectives [Sve00].

Senior managers can reveal, through analysing companies, that some knowledge bottlenecks must be solved in order to improve the performance of the company and reach the business objectives. However managers are striving to uncover which specific business contributions are down to KM solutions. By knowing the real contribution of those knowledge processes managers obtain on one hand information about the achievement of the business objectives and on the other hand to see a clear relationship between the KM solutions and the business improvements.

Managers use performance measurements to monitor key issues in businesses. These measures provide the most relevant information of the company, showing managers how the business is performing. The solution proposed in this paper provides a mechanism for monitoring KM solutions in those issues related to Business process. This new methodology is focused on the business objectives to create performance indicators (PI's) KM solutions. The goals of those PI's are to highlight the contribution of the KM solutions to business process improvements and to measure that contribution according to the business objectives.

2 Related Research

This topic is a new domain of which there is very little previous research. However, this research is based on some previous studies that are used as a foundation for the new framework and methodology.

2.1 Knowledge Management

The researchers have done a survey in the KM project field in order to get the most relevant issues. Interesting documents have been found during this survey. The works that Davenport et al [Dav00] have done in this area are interesting. They have published some important documents among which can be found specific success factors arising from KM projects are.

Davenport et al's paper is based on a survey of 31-KM projects in 23 companies and points out four common voids that have been found in those projects. These voids produced KM project failures and are proposed as effectiveness indicators for KM projects. The same authors developed another interesting paper related to KM projects [DeL97]. A classification of KM projects is proposed in a

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very practical manner. This taxonomy allows its use in a working environment because it has been directly derived from a survey of 20-KM projects in 10 companies and translated into more a concrete classification.

On the other hand, the common principles of the KM have been pointed out [Dav97]. These principles describe how the more effectively manage to more familiar issues, on a daily basis.

2.2 Performance Measurement

The performance measurement is a field to which companies have paid much attention recently. A lot of information can be found related to this topic: A comprehensive survey dealing with performance measurement systems has been published by Neely et al [Nel96].

The basis of the PM system creation has been set out [Har97, Nel97]. We can find a detailed five-step method for developing a performance measurement system. The levels in which a measurement system must be studied are [Nel96]:

- The individual performance measures
- The set of performance measures as a whole
- The relationship between the performance measurement system and the environment within which it operates

The individual measure level can be broken down in two major categories: Lag indicators and Lead indicators [Kap96]. The Lag indictors are those generic measures that tend to be core outcome measures, which reflect the common goals of many strategies; These measures do not provide an early indication about whether or not the strategy is being implemented successfully. The lead indicators are those that tend to be unique for particular business units, reflecting the uniqueness of the business strategic unit's strategy: Such measures are able to reveal whether or not a business unit is able to reach the short-term operational improvements but fail to translate them into long term business objectives.

Thus overall, there is no general consensus as to what a performance measurement should focus on. Depending on the sector in which the researcher is working on, the dimensions that a performance measurement system should address, fluctuate. However, the best-known performance measurement framework is the Balanced Scorecard [Kap96] that looks at businesses under four perspectives: customer, internal, learning and growth and financial perspective.

At the highest level two perspectives can be identified: Internal and External perspective. In the Internal perspective the performance measurement system is a part of business strategy and in the external one it is used for benchmarking purposes.

2.3 Performance Measurement In Knowledge Management

There is little research related to this topic but they can be categorised in four different groups. Some of the most interesting segments of research of each category are included in the following.

2.3.1 Knowledge measurement

Here we can include sections of research, which aim to measure the knowledge level within an organisation. In this topic, Roger E. Bohn [Boh94] in his article, *Measuring and Managing Technological Knowledge* propose a framework for measuring a particular type of knowledge: Technological knowledge. This framework can be used to more precisely map, evaluate, and compare levels of knowledge. He defines some basic characteristics of the technological knowledge and set out his framework. It ranges from complete ignorance to complete understanding passing through eight stages.

2.3.1 Measuring Knowledge Work

Other kind of measures related to knowledge is correlated to knowledge work. Carl R. Moore's article illustrates his development a set of metrics for measuring and forecasting knowledge work [Moo99]. By knowledge work, he refers to the work done thinking as software. The set of measures is oriented towards software companies, which are fundamentally based in knowledge work, for evaluating knowledge work in a function of software characteristics.

2.3.3 Measuring Knowledge Management

Alternatively, a paper related about the quality of current knowledge management has been published [Hen99]. It describes an initiative that is currently developing in Netherlands within some principle companies. They have developed, in four workshops, a framework in which companies can measure their current situation with respect to intellectual capacity and related management structure, in other words to measure how good their knowledge management is. The project is called KnowMe.

Knowme requires data acquisition from several levels: macro level, intermediate level and micro level. Macro level refers to the overall organisation, with intermediate level to teams or departments; the micro level to individual employees.

2.3.4 Micro To Macro Knowledge Management Alignment

A six-step framework to align macro to micro knowledge management has been developed [Roy00]. The purpose of

this framework is to allow organisations to determine what factors at the operational level should be measured in order to fulfil the strategic objectives of the business. The stages of this framework are

- Determine which issues to address within the KM project
- Locate specific measures of the issues determined in the first state
- Examine the interactions between the measures and the process, and between the different measures

On the other hand, he has addressed the difference between Macro and Micro Knowledge Management. He stated that Micro KM is "where the work gets done. At the operational level: KM projects being conducted within the organisation. *How* the business will achieve the KM targets is determined at this level". By Macro KM, he pointed out that it is "where the work gets done. At the operational level: KM projects being conducted within the organisation. *How* the business will achieve the KM targets is determined at this level".

3 A Gap In The Business Measurement

3.1 From The Strategic Level To The Operational Level

Performance measurement systems are key in today's businesses. They allow not only monitoring of the business performance according to the business objectives but also assess the performance in comparison with similar company performances by benchmarking.

Many PM systems have been set out but the most popular is the Balanced Scorecard (BSC). Those PM systems like the BSC are characterised by the mixture of two kinds of performance measures: lag indicators or core outcomes in the strategic level and lead indicators or performance drivers in the operational level. Within the BSC for example companies are seen under four perspectives (financial, customer, internal and learning and growth). The lag indicators represent the core outcome measures of the company but just tell managers how well the company has performed as a whole.

Lag indicators are derived from the business objectives in order to represent the company performance according to the business goals. They are lagging measures, reporting how well an organisation's strategy worked within a previous time. Coupled with this, they are generic, in that all companies are trying to improve along these dimensions. Examples of Lag indicators in the BSC are gathered in the Figure 1.

This gap is filled by the lead indicators, which highlight the performance of the particular issues of each company. Somehow, the organisation's high-level strategic objectives and measures need to be translated into actions that each individual can take to contribute to organisation's goals. However, many organisations have found it difficult to decompose highlevel strategic measures, especially nonfinancial ones. Such lead indicators are different according to the domain in which they are going to be applied and the characteristics of the business. In an example provided by the BSC, in the Product Development department one of the core outcome measure was time-to-market but a lead indicator that was added to this lag indicator was the percentage of products for which the first design of a device fully met the customer's functional specification.

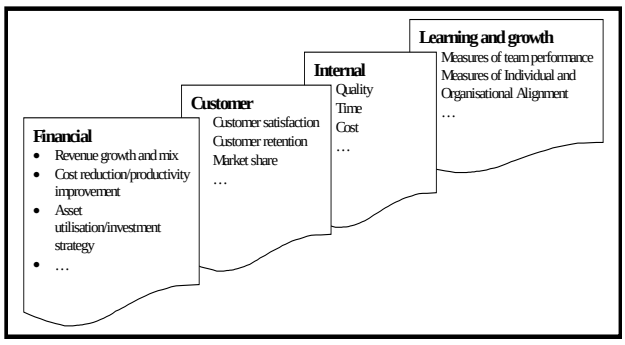

Figure 1: BSC perspectives and strategic measures

Examination of the KM domain reveals KM solution contributions can be reflected in those lag indicators. However KM contribution is more valuable each time and requires that the lead indicators monitor knowledge performance.

Of course, the main interest of such lead indicators is to clearly express the KM contribution to the business objectives. This point implies that the lead indicators should be derived from those business goals.

3.2 KM Solutions And KM Processes In The Operational Level

KM initiatives are aimed to provide KM solutions to solve knowledge bottlenecks previously identified in Business processes at the Operational level such as Innovation or Production. These Knowledge bottlenecks can be identified through Knowledge mapping and the identification of the possible opportunities of improvement.

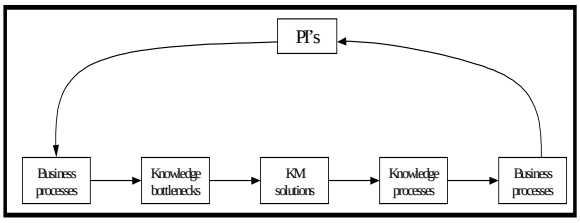

Figure 2: Integration of the measurement issues in the KM issues

KM solutions are composed of knowledge processes such as Knowledge capturing or knowledge sharing which are implemented to improve those Business processes. Currently, businesses have a complete measurement system, including all the Business processes but now with the introduction of the Knowledge processes, a new gap has emerged. The contribution of the Knowledge processes can be measured by the improvement on the business Lag indicators but there is a lack of KM solution lead indicators.

Through the implementation of the new KM solutions, a gap has been created: The new methodology aims to cover this gap.

3.3 The Gap

The gap has been outlined previously. On one hand the Lag indicators measure the performance of the Business with respect to the Business objectives and on the other hand there are new Knowledge processes that solve the Knowledge bottleneck in the Business processes. There is measures are required in order to help monitor the efficiency and effectiveness in the Knowledge bottlenecks solving in order to achieve the Business objectives. The Figure 3 shows the gap in a whole organisation map.

4 Measurement Framework

4.1 The Framework Requirements

The purpose of this framework is to allow organisations to complete the performance measurement systems by adding Lead indicators that measure the performance of Knowledge processes implemented in a Business process as a result of a KM initiative. Examining the origins of this framework exposes its requirements, which can be gathered in two main points:

- To develop Performance Indicators to measure Knowledge process performance
- To develop Performance Indicators that monitor Knowledge processes according to the Business objectives

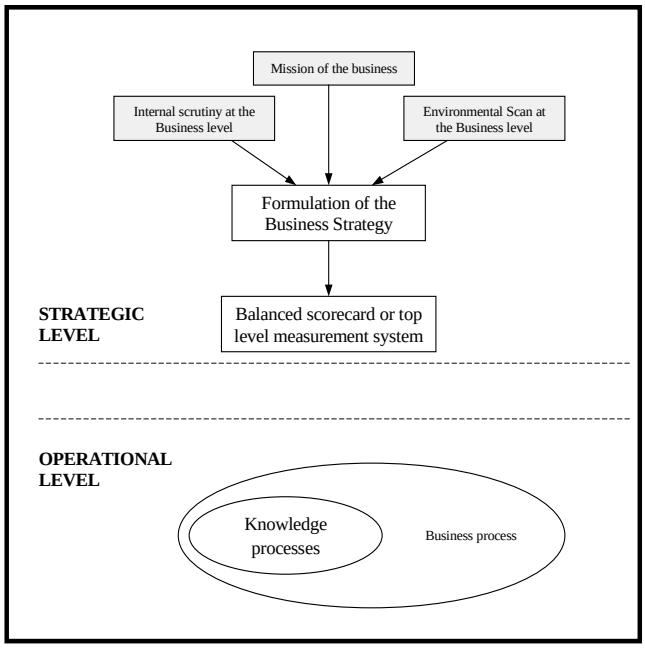

Figure 3: The gap

4.2 Framework

The framework (Figure 4) is divided into three stages, (stretching from the strategic to the operational level) in which the measures are developed starting from the Business objectives that ensures the focus of the measures. These stages contain the six-step framework that bridges the previously described gap between the strategic and the operational level. The stages of the framework are:

1. development of the strategic measures from the business strategy (steps: 1, 2)
2. creation of the lead indicators for the Knowledge processes (steps: 3, 4, 5)
3. implementation of the measures (step: 6)

The first stage of this framework is given by the current development of PM systems in companies. The KPI development starts in the second stage and drives to measures able to monitor KM solution performances. The proposed framework is intended to be generic, but requires further validation. A case study of this framework is included in the next section.

4.2.1 At The Strategic Level

This first stage of the framework contains two steps. The aim of this stage is to develop the top-level measures that can monitor the performance of the Business according to the business strategic objectives. Within the first step the Strategy of the business is defined and based on it, the strategic measures are created through a top-level measure development framework, similar to the BSC during the

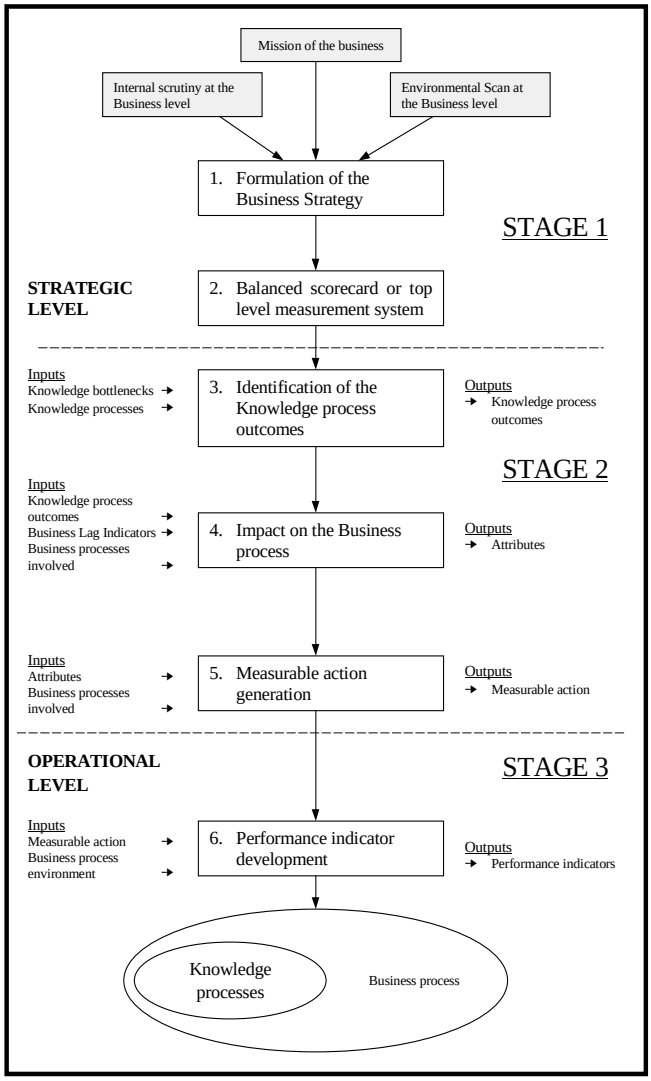

Figure 4: Six-step framework

second step. The measures that are obtained at the end of this stage are the strategic measures or lag indicators. The lag indicators can tell whether or not the strategic objectives are going to be reached but are deficient in monitoring the operational level processes based on the strategic objectives.

4.2.2 Bridging The Strategic And The Operational Level

The second stage of the framework is where the measures are derived, and holds three steps. Throughout this stage three steps are allocated. During the third step of the framework, the Knowledge process outcomes are brought to the PI development. KM projects typically identify the knowledge bottlenecks with in a process and to solve them is the requirement of any KM solution. KM solutions are composed of Knowledge processes that provide knowledge outcomes to address the knowledge constraints of business processes (Figure 5).

The Knowledge process outcomes solve the Business process knowledge bottlenecks, so those outcomes have to be measured to monitor the performance of the KM solution. Those outcomes are taken as entities in the way that they are elements that has influence Business processes. The practitioner can find the Knowledge process outcomes for each Knowledge bottleneck looking at KM solution provided by the KM project.

In the fourth step, practitioners analyse each outcome, in order to discover and measure the influence of they have in the Business processes and measure them. On the other hand, the new measures have to take into account the company strategy in order to set out the contribution of the KM solution to the Business objectives as was said in the framework requirements. This is expressed through the Business process lag performance indicators that have been directly derived from the Business strategy (Figure 3). The business processes are also important in order to develop the PI's. By knowing the environment in which the measurement is taking place practitioners can develop suitable PI's for each specific environment. The measurement of the knowledge captured and located in database for a Product Development department is no comparable to that of a Marketing department.

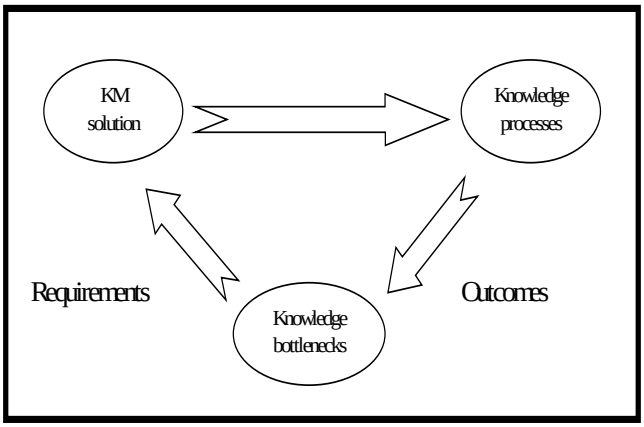

Figure 5: KM project

Looking at the outcomes as entities, the practitioners have to discover the attributes of the entities. The attributes on which the practitioners are interested are those that express how the entity is contributing the Business process to reach the Business objectives. This "how" is the key to get the PI's and takes place in the following step.

By knowing how the outcomes are contributing to the Business process and which Business process is involved, the measurement can be highlighted by a measurement action. Such actions are pointing out a specific issue in the

Business process and the measure can be taken according to characteristics of the business process in which the Knowledge bottleneck was found. Those issues are defined during the fifth step of the framework.

4.2.3 At The Operational Level

This is the third and final stage of the framework. The measures exit but are not implemented. It is important to understand which effect the measures will have on routine operations of the organisation or if can be mapped into existing operational measures. According to the measures obtained through the framework, the implementation is different and requires a detailed study for each case.

The results obtained with this approach can be categorised into two groups: objective and subjective measures. The objective measures are related to issues, which provide a value that can be compared in order to follow the evolution of KM solutions and the improvement on business processes. The subjective ones provide information about the KM solution performance from the viewpoint of business process workers.

The objective measures are preferred due to the simplicity of the measurement and ease of comparison among differing measurements. On the other hand, they are not affected by the subjectivity of the people that fulfil the questionnaire or that are interviewed. However, those measures are not always feasible. The objective measures monitor the performance of KM solutions within business processes and could be susceptible to influence from other projects that could be implemented in the business process such a process has been referred to as overlapping in this research.

4.3 Case Study

The researchers propose the following case study with the aim of showing how the framework works. This case is focused on the production department. The whole business is monitored by a PM system as any other company. The BSC is taken as the PM system and allows senior managers to control the business under four perspectives (Figure 1). The KM project that has been developed for this case attempts to improve the efficiency of this production business process. The measures that control the production business process performance are gathered in the Internal perspective of the BSC (Figure 1).

Within the business process, the KM project identified the knowledge bottlenecks that constrained the production line. Consequently, the KM project proposes a KM solution in which the knowledge bottlenecks are addressed. This case study focuses on a particular knowledge bottleneck within the KM project. It is “Improvement in knowledge sharing across shifts”. As a result, the KM solution proposes to implement a knowledge sharing process. One of the outcomes targeted by this knowledge process is the “improvement of the standardisation”. This whole process constitutes the third step in the framework providing the previous knowledge process outcome.

The knowledge process outcomes are considered as entities. Entities are processes that have an influence on business processes as was previously stated. The fourth step of the framework aims to analyse the influence of this entity on the business process in order to obtain the attributes of the entity that solve this knowledge bottleneck. The researchers refer to attributes by the way of describing entities that are improving the business process.

KM solution model		**Opportunities for the measurement solution**
K. bottleneck		Improvement in knowledge sharing across shifts
Entities (Outcomes)		Improvement of the standardisation
Impact on the Business process	Comp. dimension	Quality
	Departme nt	Pre-processing/ Processing/ Packaging
	How? Attribute	The implementation of the best practices will increase the quality of the production by reducing the number of defects on the Production line
Measurable action (MA)		Reduction of defects due to the implementation of the best practice and similar performance among shifts
Performance indicator		Ratio: Number of defects/average number of defects among shifts

Figure 6: Case study

For this step, information about the business lag indicators and the department involved is required. That information highlights that the entity improves the business process: “The implementation of the best practices will increase the quality of the production by reducing the number of defects in the production line”.

With this entity attribute and further knowledge about the business process involved, the action that should be measured is highlighted. This measurable action achieved in the fifth step of the framework is on which practitioners should focuses in order to come up with the measure. The measurable action in this case study is “Ratio: Number of defects/ average number of defects among shifts”.

5 Discussion

5.1 The Framework Focus

KM is emerging in today's business as a new tool to deploy the intellectual capital of the business and improve the business performance. Those opportunities are becoming the KM domain a key area in order to get competitive advantage and in consequence the necessity of controlling how well the KM solutions are performing in businesses is also imperative.

Those KM solutions are implemented to solve knowledge bottlenecks in a particular Business process such as production or marketing among others. In today's companies PM systems monitor the performance of all the Business processes but a new gap in this PM system has been introduced, with the implementation of a KM solution in a Business process. The necessity of new measures becomes evident, to control the contribution to Business processes of KM solutions in order to allow managers to monitor Business processes perfectly.

The main point at this stage is to know how to monitor those KM solutions. The measurement should be driven by some objectives or goals in which are reflected the performance of the KM solution is reflected. The most useful manner to assess the performance of the KM solution is with respect to the business objectives. However, the business objectives are not explicit enough to be applicable to that low level of business. The solution provided by this framework is to follow the PM system that has been monitoring the business so far and to develop PI's based on the Lag indicators of the PM system to measure the performance of each business process.

5.2 Usage Of The Framework

Although an example of PI creation has been included comments can be incorporated with respect to the framework characteristics. The managers of today's businesses would like to vividly see all operations implemented in companies and one of the principal requirements that the researchers set out before developing the framework was the transparency of it.

To avoid this black box effect, the PI's development is easily drive through a set of little steps that start from the outcome identification to the PI generation passing through an easily understandable analysis of the impact of the outcome on the Business process.
Another point that should be highlighted is the easy usage of the framework because it does not require a big knowledge from PM systems, due to its clear PI development way. This is an advantage for reducing the implementation cost of the PI development.

The interference of the developed measures with other projects implemented in the same Business process at the same time can drive to an incorrect analysis of the KM solution effect and would invalidate the usage of objective measures. In these cases, subjective measures are recommended in order to show the real effect of the KM solutions in a qualitative way.

6. Conclusions

Measuring performance of Knowledge Management solutions to achieve business objectives is becoming popular in industry. An initial study confirmed that there was no framework that aims to measure the effectiveness of KM solutions to achieve business objectives.

This research has developed a 'step by step' framework and a methodological approach to identify the Key Performance Indicators (KPIs) for KM solutions. The conceptual framework connects the strategic measurement tools to KM solutions at the operational level. The methodological approach provides practitioners with a set of templates that help them to carry out the conceptual framework. Both of them together produce a structured way to develop KPI's according to the business objectives. The framework is validated on two real life KM projects from the sponsoring company.

The KPI's developed with this framework measure the effectiveness of the KM solutions in business processes. That allows companies not to only monitor if the knowledge is being managed right but also if the right knowledge is being managed within the company.

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