Modeling the Knowledge-Value Chain

A knowledge-value-chain (KVC) model was developed that includes an optimization technique to identify the nodes (individual employees or groups of employees) of the critical-value chain (CVC) and optimum-value chain (OVC). The model has business and numerical phases composed of input knowledge, knowledge activities, and output values (goals). The input knowledge comes from several sources and will converge toward an enterprise-information portal (EIP). The value-added knowledge activities are based on socialization, externalization, combination, and internalization of knowledge.

This article, written by Technology Editor Dennis Denney, contains highlights of paper SPE 87027, "A Study on the Modelling of Knowledge-Value Chain," by ***Yeong-Long Chen, Tzer-Chyun Yang,*** *and* ***Zsay-Shing Lin,*** *SPE, National Cheng Kung U., prepared for the 2004 SPE Asia Pacific Conference on Integrated Modelling for Asset Management, Kuala Lumpur, 29–30 March.*

Introduction

In 1996, the Organization for Cooperation and Development reported that the knowledge-based economy would change the activities of the global economy. Knowledge has become a driving force for production and economic growth. The World Bank indicated that economic growth in the knowledge-economy era is based on human capital accumulation, core-capability applications, and the acquisition and use of information and knowledge. Much interdisciplinary research such as biochemical science, biotechnology, nanotechnology, information technology (IT), and wireless communication technology has resulted in a great revolution of human life.

An interdisciplinary KVC model was developed to monitor and evaluate the contributions of knowledge activities. The model was used to examine the strengths and weaknesses of individual-employee core competences, to identify the critical knowledge workers, and to calculate their maximum-value contribution. The full-length paper presents a detailed literature review to describe the basis of this model. Topics include the next society, value chain, spiral of knowledge, balanced scorecard, multiple intelligences, 80/20 rule, and optimization theory.

KVC Model

As **Fig. 1** shows, the KVC model consists of three parts: input knowledge, knowledge activities, and output values.

Input Knowledge. In the next society, information and knowledge will be acquired easily through intranets, extranets, and the Internet. Knowledge flow will converge toward the EIP. Knowledge flow also may come from non-IT channels, such as tacit knowledge (knowledge that is implied by or inferred from actions or statements) and explicit knowledge (knowledge that is fully and clearly expressed, leaving nothing implied). All knowledge will be integrated into knowledge repositories.

Knowledge Activities. Financial margin and business value can be achieved with value-added activities. This concept extends from the value chain to the spiral of knowledge. The spiral of knowledge postulates four interaction processes—socialization, externalization, combination, and internalization—that transfer individual-employee knowledge to company knowledge. Knowledge value can be increased and integrated by these four value-added processes. The second part of the model, knowledge activities, combines the applications of the value chain and the spiral of knowledge.

Output Values. The authors propose that the output values of knowledge activities should be diversified. Multiple values of knowledge contribution should be selected; thus, the model can identify the strengths and weaknesses of the employees' competitive advantages.

Fig. 2 shows the integrated model that includes input knowledge, knowledge activities, and output values. Multichannel input knowledge will converge into knowledge repositories, and the four interaction processes of the spiral of knowledge are the core value-added activities. The diversified output values, based on the balanced scorecard and multiple intelligences, are key to delivering the CVC and the OVC.

The KVC model also indicates that the knowledge-value-added process makes a two-way contribution: forward and backward. For example, the value-added processes from knowledge activities contribute forward to the next stage (output values) and backward to the previous stage (input

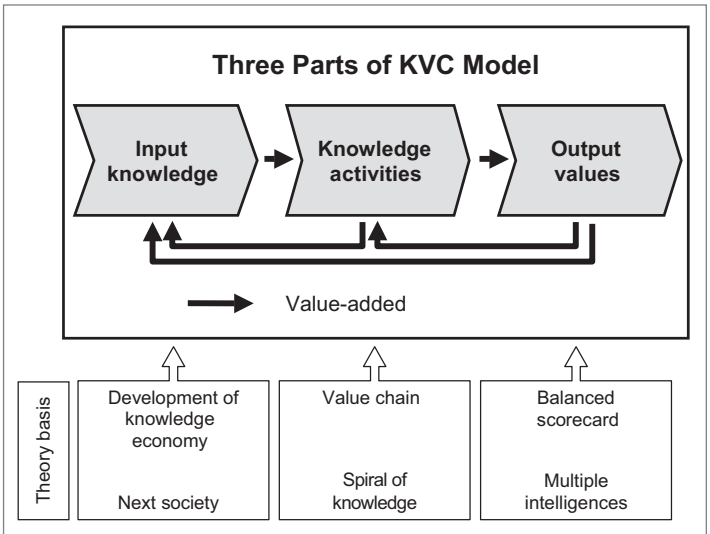

Fig. 1—KVC-model parts and theories.

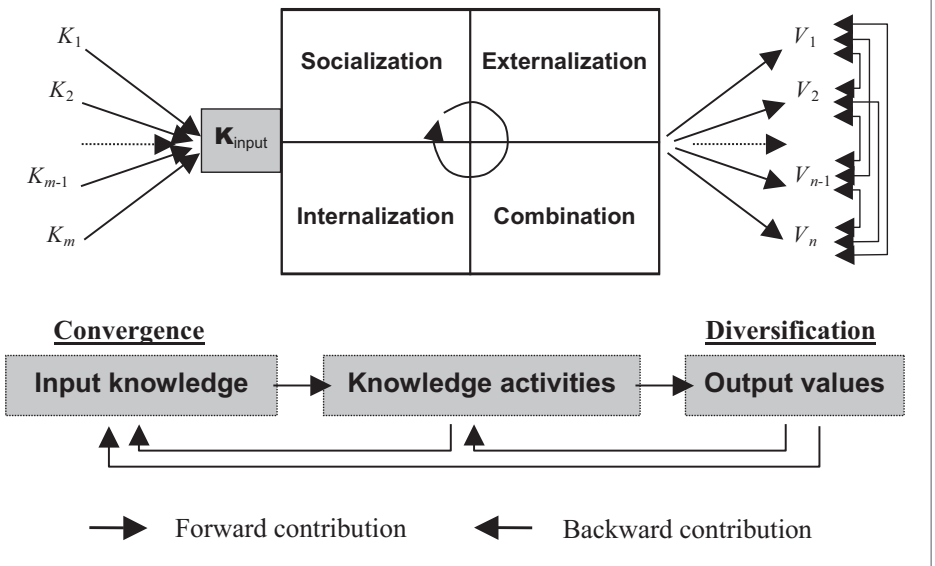

Fig. 2—KVC model. K=knowledge; V=value.

knowledge). Similarly, the results from the output-value stage also can make contributions to the previous stage (knowledge activities) and even to the earliest stage (input knowledge).

CVC and OVC

These applications are key to the KVC model. The study defines the node (or nodes) of the value chain as an individual (or a group) who contributes the knowledge values. Two hypotheses are considered.

1. The value contribution of knowledge activities should have corresponding nodes on the value chain.
2. Knowledge can be accumulated and value added progressively by interaction of the nodes.

Simplified KVC Unit. The applications of the model include the business and numerical phases. The main objective of the business phase is to deliver quantifiable performance of knowledge activities. The quantifiable performance (i.e., output values of the business phase) can be used as input parameters in the numerical phase. The purposes of the numerical phase are to identify the critical nodes of the value chain with the CVC process and to determine the maximum business value and optimum combinations for each goal with the OVC process. The identified critical nodes and the optimum combinations of each value provide helpful strategies for knowledge activities in the next business phase.

CVC. Among a group of knowledge workers, only a few of them may be responsible for contributing most of the knowledge values. The phenomenon of value contribution is defined as a CVC. If an enterprise could identify the critical nodes, most of the performance would be achieved effectively.

OVC. The OVC is defined as the optimum combinations of multiple values to achieve a maximum number of business goals. When the diversified goals are set, the objective function can be determined by giving weighting coefficients for each goal. If constraints also are defined, an optimization technique can be used to calculate the maximum value and determine which combinations of variables are optimum.

Case Study

K Company has been a leading international designer and manufacturer of musical instruments for more than 70 years and has approximately 4,000 employees around the world. Some of its products rank among the top 10 in the world. K Company is aware that the more knowledge and experience it has, the greater its competitive advantage. To increase its competitive advantage and business success, it began a knowledge-management project in August 2002.

Six months after implementing the project, the company applied the KVC model to evaluate the strengths and weaknesses of its knowledge workers, to determine the CVC, and to calculate the OVC. The project had three core activities.

1. Acquisition and sharing of knowledge, such as document management.
2. Interaction and innovation of knowledge, such as communities of practice.
3. Learning and dissemination of knowledge, such as best practices of experts.

Multiple Goals. Multiple goals were identified before implementing the KVC model. For each goal, indicators of IT performance and work performance were set up. There were approximately 10 IT indicators and 10 work indicators for each goal, and five-point criteria were defined for each indicator. K Company could, therefore, evaluate the goal achievement of its knowledge workers every quarter by use of the 5-point criteria in every indicator.

KVC Model. Knowledge repositories, one of the resources of input knowledge, are integrated into the EIP. The input knowledge of K Company has repositories for marketing, manufacturing , R&D, quality control, management, finance, and music. Explicit knowledge from the intranet, extranet, and Internet would also converge toward the EIP. Tacit knowledge from employees or experts, however, should be captured by communities of practice or other interaction activities.

The main knowledge activities are the acquisition and sharing of documents, interaction and innovation of communities, and learning and dissemination of best practices. Value contributions were evaluated with preidentified indicators. The knowledge workers' performances were evaluated from the knowledge-management system and by their line managers.

The output goals were diversified. Multiple-value contributions were defined by combining the balanced scorecard's four perspectives with an additional innovation goal. K Company selected financial profitability, customer satisfaction, business-process improvement, learning and growth, and innovation encouragement in its KVC model. The purposes of the KVC model were to evaluate the strengths and weaknesses of knowledge workers, to identify the critical nodes of the value chain, and to find the OVC.

Results. Although value contributions of IT performance were recorded daily, the evaluation reports of knowledge value were announced only quarterly. The quarterly report addressed the strengths and weaknesses of each department and individual employee. This report also identified critical nodes (winners' nodes or high-performance

employees) for each goal. Furthermore, an optimum combination of the goals to reach maximum values was calculated.

The number of knowledge workers participating in the model was 275, and the first evaluation period was from 1 April to 30 June 2003. The results offered three key findings. First, the strengths and weaknesses of individual-employee core competences were examined. Second, the critical nodes were determined for each goal, and the selected critical nodes were gathered together to share their best practices. Third, the optimum goals to reach the maximum value contribution to K Company were calculated.

After running the KVC model, three of the five goals—financial profitability, business-process improvement, and innovation encouragement—showed typical 80/20 patterns, which enabled identifying critical nodes. Critical nodes were not easily determined for the other two goals because of unusual 80/20 patterns. The employees represented by the selected critical nodes will be gathered together to share their best practices in a series of innovation communities and strategic workshops. The objective of holding the communities and workshops is to create innovative plans for new products, services, or solutions. In addition, larger rewards and higher performance will be achieved in minimum time and at lower cost by concentrating limited enterprise resources on the right team after the critical nodes are identified.

K Company had not used the KVC model long enough to acquire sufficient data to determine constraints. The objective function can be defined easily as long as the top manager identifies the weighting factors of these five goals. However, the greatest difficulty before running the OVC is defining the constraints.

Conclusions

The KVC model was applied to K Company in Taiwan and resulted in three key findings. First, the strengths and weaknesses of each individual employee's core competences were examined. Second, the critical nodes (winners' nodes or high-performance employees) of each goal were determined. Third, the optimum goals to reach the maximum value contribution to K Company were calculated.

The KVC model can be used to assess the strengths and weaknesses of the core competences of knowledge workers. It is helpful to check whether the right people are doing the right jobs and to provide managers with an understanding of a unit's achievements.

The CVC identifies the critical-value-contribution nodes by use of the 80/20 rule. The selected nodes then are gathered together to share their best practices. Larger rewards and higher performance will be achieved in minimum time and at lower cost by concentrating limited resources on the right team.

The OVC concludes that once some goals have achieved optimum value, the resources originally used to achieve this goal should be shifted to support the other ongoing goals. The OVC suggests that the maximum value of a goal may not be its optimum value. JPT

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