Knowledge Management and Innovation in Indian small scale industries: A System Dynamics Approach

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Abstract

The small-scale industries (SSI) sector plays a vital role in the growth of the Indian economy. It contributes almost 40% of the gross industrial value added in the Indian economy. This sector creates largest employment opportunities for the Indian population, and is second to the agriculture sector. Though, there is a huge potential for the growth of SSI in India, the problems faced by them are in manifold. One of them is huge employee turnover. Employees don't tend to stay in the organization primarily due to the salary and remuneration factor. This has led them to embrace Knowledge Management (KM), but in its crude way as implementation of KM is it is capital intensive. This paper studies the practice of SECI model in SSI and simulates the same using system dynamics.

Keywords:

Knowledge Management, Innovation, SECI model, System Dynamics, and Small scale industries.

Introduction

A noteworthy feature of the Indian economy since its independence has been the rapid growth of the SSI sector. Over the past five decades, successive governments have framed policies protecting the interests of the sector and facilitate its rapid development.

SSI have emerged as a lively and dynamic sector that contributes around 40 per cent of the total industrial production and over 34 per cent of the national exports to the Indian economy. Although, there is a huge potential for the development of SSI, the growth has been plagued by problems such as problems of skilled manpower, inadequate credit assistance, irregular supply of raw material, absence of organized marketing, lack of machinery and equipment, absence of adequate infrastructure, competition from large scale units and imported articles, and other problems like poor project planning, managerial inadequacies, old and orthodox designs, high degree of obsolescence and huge number of bogus concerns. Amongst these, the most important problems are manpower problems and competition from large scale units and imported articles.

The main issue with SSI are that they don't have deeper pockets to spend. Hence, the employees do not enjoy a good remuneration resulting in large employee turnover. This creates a problem of unfinished projects, incomplete jobs incomplete, defacing the reputation of the organization, and in many cases even closure of businesses. This is because the existence of an efficient, trained and developed workforce is the key to survival of an organization in the current global scenario.

In this regard, Knowledge Management (KM) plays a vital role in capturing the tacit knowledge of the employees and suitably codifying it so as to enable quick decision making, and ensure that turnover has minimal effect on the ongoing projects.

Being capital intensive, SSI often face it as a problem while implementation of KM. This doesn't mean that it is the end of the road for the SSI sector. Basic models of KM can be still utilized to reduce the damage. Nonaka& Takeuchi, (1995) explained the four modes of knowledge creation or conversion that are derived from the two kinds of knowledge viz. tacit, and explicit.

1. Socialization: from tacit to tacit
2. Internalization: from explicit to tacit
3. Externalization: from tacit to explicit
4. Combination: from explicit to explicit

This paper studies the effect of implementing the SECI model in an Indian SSI located at Manipal and delineates the effect of the time based policy parameters on the system.

Literature Review

In India, 95 percent of industrial units are in small-scale sector with 40 percent valueaddition in the manufacturing sector and 6.29 percent contribution to the Indian grossdomestic product (Singh *et al*., 2008). Though, there has been serious steps from the Government to ensure its longevity, there are evidences that, SSIs are struggling for their survival.

Today's intense competition requires that firms excel simultaneously in several areaswithout trade-off, including innovativeness and responsiveness to their customers (Corbett and Campbell-Hunt, 2002). Capacity of a firm to maintain reliableand continuously improving business and manufacturing processes to meet abovechallenges appears to be a key condition for ensuring its competitiveness in the long run(Lagace and Bourgault, 2003).

Globalization and IT revolution have changed the dynamics of business in the last decade. A better remuneration coupled with a metropolitan life style attracts the youth to go to cities in search of greener pastures. Ngai and Wat (2002) argue that globalization and information technology (IT) areradically changing the face of business and organization. IT has become the majorfacilitator of business activities today. However, there is a darker side to it. Being capital intensive, SSI find IT integration a challenge as they have limited sources of funding. This puts them in a position where they cannot develop state-of-the-art KM systems like the medium or large scale industries and hence have to adapt to the traditional models which are less capital intensive. Revisiting KM theory, several models for knowledge flow and knowledge lifecycles have been proposed that capture the dynamics of knowledge, its transformation and relationship to the respective application context (Nonaka and Takeuchi, 1995: Borghoff and Pareschi, 1998: Fischer and Ostwald. 2001). One such model is propounded by Nonaka and Takeuchi (1995) called as SECI model. This model highlights the four basic modes of knowledge transfer called socialization, externalization, combination, and internalization.

In this manuscript, all the above referred facts have been the key variables of interest in developing the SD model to the study of HR dynamics owing to their influence on KM and Innovation of a manufacturing firm.

Research Methodology

The research methodology goes in accordance to the principles of System Dynamics methodology proposed by Forrester (1994). This includes: Problem identification, System Conceptualization, Model formulation, Simulation & validation, and Policy analysis & improvement (Sushil, 1993). The problem identification stage involves the identification of variables (Checkland and Holwell, 1998) considering the key variables which have influence on Innovation in a manufacturing firm. Table 1 shows the different variables and constants that were used in the simulation.

Table 1: Variables and constants used for simulation

Variable Names	Base	Trial 1	Trial 2
Rate of knowledge through externalization (ROKE)	0.5	0.6	0.7
Rate of knowledge through internalization (ROKI)	0.5	0.6	0.7
Rate of knowledge through combination (ROKC)	0.5	0.6	0.7
Rate of knowledge through socialization (ROKS)	0.5	0.6	0.7
Redundancy factor (RDNF)		0.6	
Hit Rate		0.1	

Using the causal loop diagram (Fig. 1) as a starting point, the stock and flow model (Fig. 2) is set up for simulation in Ventana Systems VenSim modeling environment. Despite the dynamic nature of system models in general, the model has some constants, which reflect the assumptions made, to provide the basis for the model (Table 1). Using constants eases the modeling, but they also create an error source of their own. Assumptions behind constants attributes should be made logically so that the model stays intact.

The constants presented at Table 1 realize that they are mostly market and industry related assumptions, even to that extent that these factors contain all the determinants of firm's business environment build in the model. This enables that the model can be customized relatively easily to new market settings by altering these constants. The numbers used in this simulation are based on rough estimates from experience from business cases, and aim to replicate a sort of general industrial firm. Thus the results are also reported mainly for the purpose of highlighting the dynamics of the model more than anything else.

Figure 1: Causal loop diagram

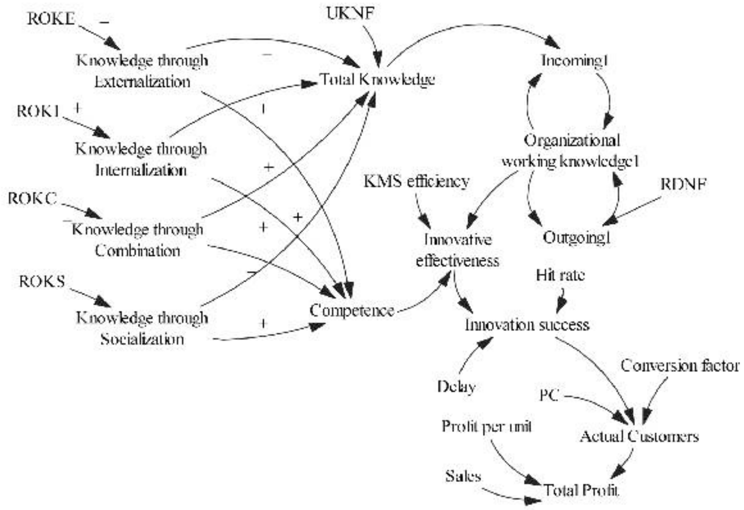
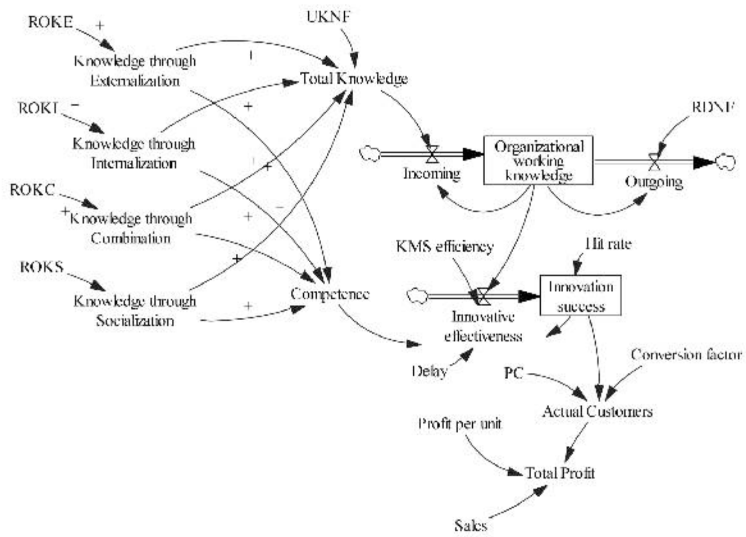


Figure 2: Stock and flow diagram



Model Structure

As briefly mentioned, a system dynamics approach to model the knowledge creation and acquisition dynamics within a manufacturing industry is considered.

Knowledge conversion within a firm

According to Nonaka and Takeuchi (Nonaka and Takeuchi, 1995), knowledge creation is the capability of a company as a whole to create knowledge, disseminate it throughout the organization, and embody it in products, services, and systems. They established a dynamic model of knowledge creation. In this model, they explained a critical assumption that human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge. Knowledge conversion takes place through an iterative and spiral process of Socialization, Externalization, Combination and Internalization – or SECI .

- In Socialization, the first stage, each person's tacit knowledge is converted to tacit knowledge now also held by other members in the firm. Socialization is primarily a process between individuals and occurs in settings such as apprenticeships and at conferences.
- In the next stage, Externalization, tacit knowledge is articulated and converted to explicit knowledge comprehensible to others, e.g. writing a report after attending a workshop. Externalization is a process among individuals within a group.
- During Combination, the third stage, this newly explicit knowledge becomes widely disseminated, discussed, redesigned and modified. This is the area where information technology is most helpful, because explicit knowledge can be conveyed in documents, email, databases, as well as through meetings and briefings.
- The final stage is Internalization. Internalization converts the changed, explicit knowledge again to a tacit form, this time held by many people. The internalization process is closely related to 'learning by doing' and transfers organization and group explicit knowledge to the individual.

Knowledge transfer and creation within an industry

Similar to Nonaka's framework whereby tacit knowledge developed within one organizational unit is made explicit, transferred to another unit, applied within the new unit and thereby made tacit again; firms develop and transfer knowledge among themselves within their industry (Zack, 1999a). An organization develops tacit knowledge as a byproduct of its activities. This knowledge may be made explicit to facilitate its transfer among other units of the organization. In doing so, it may leak out of the organization into the industry at large. At the same time, the organization may be absorbing knowledge leaking out of other firms within its industry, and internalizing that knowledge through its reapplication within the firm.

Competitive knowledge and capacity of innovation

The loop for knowledge creation and transfer within an industry can be further extended with what Zack has defined as Strategic Knowledge or the Organizational Working knowledge- the knowledge the firm needs to execute its strategy (Zack, 1999b). He states that just a portion of the knowledge the firm possesses is strategically important as a source of sustainable competitive advantage, because such knowledge is highly valuable, unique to the organization, difficult to imitate and difficult to substitute (Barney, 1991). This introduces a factor called as Redundancy factor. Redundancy factor is the factor which includes redundant data, incompletely processed data and other factors.

According to Zack (Zack, 1999b) every firm's strategic knowledge can be categorized by its ability to support a competitive position.

Core knowledge represents the basic knowledge required to operate in an industry. And it is usually common to all members of an industry.

Advanced knowledge differentiates a firm, enabling it to compete and remain viable. Some firms compete head-on in particular knowledge domains, hoping that their knowledge is better than the competitors. Other firms seek to differentiate themselves based on what they know.

Innovative knowledge is truly unique and enables a firm to significantly differentiate itself from its competitors. It is obvious that knowledge is not static and what is innovative knowledge today will ultimately become the core knowledge of tomorrow. In our model, the advanced knowledge and innovative knowledge are unified into a variable called competence. By employing this important resource, an organization is able to create a higher economic value for its customers. This in turn implies that the firm can gain more financial resources than can its competitors (Almor and Hashai, 2004). The more financial resources the firm possesses, the more it can allocate to knowledge sharing and combination within the firm and therefore, it can accelerate its learning cycle.

The fruits of Innovation and Knowledge Management on firm's performance

The level of competencies is determined by the innovative capabilities of the people of the organization. Innovative capabilities grow from either deployment through learning-by-doing achieved in innovation process, or by basic research. These variables are determinant on how firm can perform these activities. The logic in the model is that the innovative capabilities affect the ability of the firm to develop good products. Learning in turn affects the innovative capabilities. The learning function employs the logic of diminishing return so that the incremental learning from each decision is larger when the quantity of screening decisions is smaller.

The innovative capabilities, or the level of the knowledge stocks, affect the success rate of NPD and product launch. Adhering to the theory of absorptive capacity, when the firm has above average technical capability, it produces better product ideas as the decision makers are able to recognize technological opportunities better and develop novel solutions to fill customer need. It is described under the variable named as productivity factor.

Results and conclusions

Three runs were simulated; the first run called as a base run, was a case of low implementation of the SECI model in practice. The firm under consideration displayed not a appreciable trend in terms of Organizational Knowledge (Figure 3), and hence, the innovative ability was not very promising (Figure 4). Also, one can observe that, the initial profits (Figure 5) were higher than the other two runs, but there was no considerable appreciation. On the other hand, trial 2 and trial 3 saw an exponential increase in organizational knowledge and hence on the innovation success. One could also observe an interesting trend that in all the three cases, the innovation success didn't change for the first 6 months, but from the 7^{th} month, they began to grow at different rates. Also, the initial profits that the firm made was the least in the trial 2. One could observe that, it trailed for the first 15 months, then shot exponentially, meaning that, the firm has to spend some money in motivating the employees to share knowledge by providing incentives and other schemes.

Figure 3: Organizational working knowledge

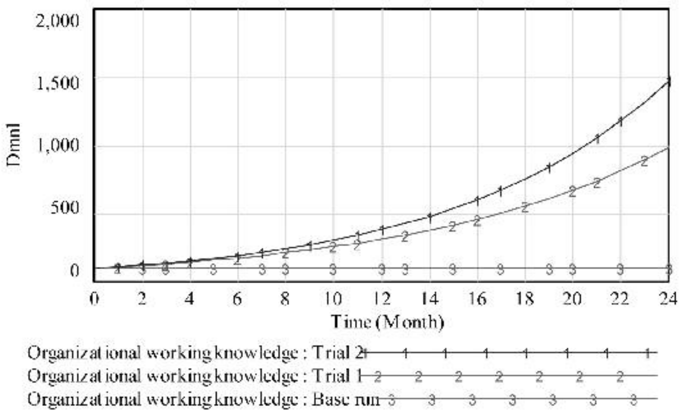


Figure 4: Innovation success

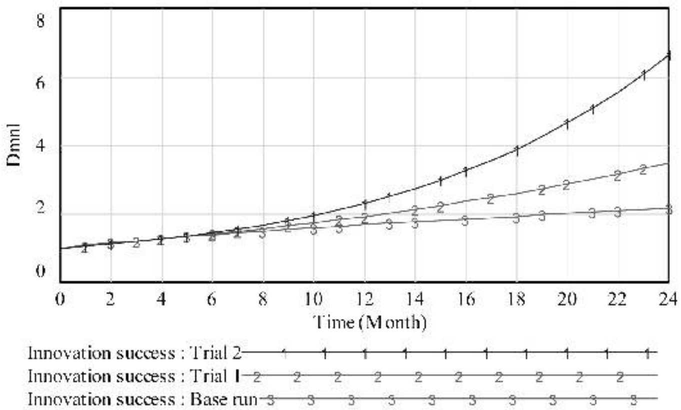
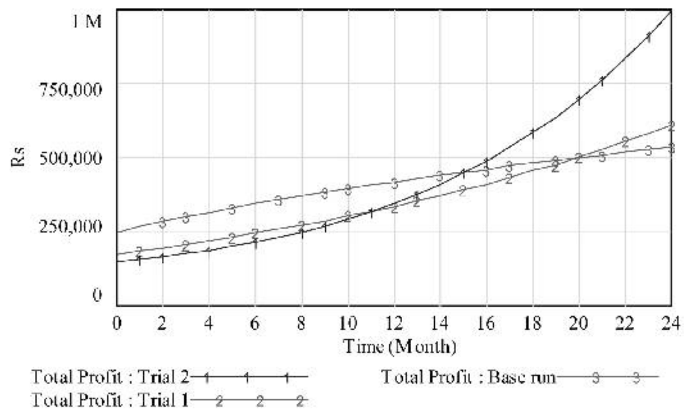


Figure 5: Total profits



Through the above results one can conclude that, KM can still work in SSI irrespective of technological support by means of simple knowledge sharing models existing in the literature. Also, this research reinforces the fact that IT is an enabler of KM and not a pre-requisite. KM is more driven by the people and the process core, and technology is just an add-on. Technology plays a key role when the companies are scattered geographically and where there are huge data to be processed in order to make strategic decisions for the benefit of business. When it comes to SSIs, KM plays a vital role in innovation and firm productivity, but the localization of the firm and the type of data analysis required is very small and hence doesn't require a high end infrastructure. In simple terms KM in SSI can sustain without a high end IT support.

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