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ModelingAdoption Rate ofKMS by a Knowledge worker:A System Dynamics Approach

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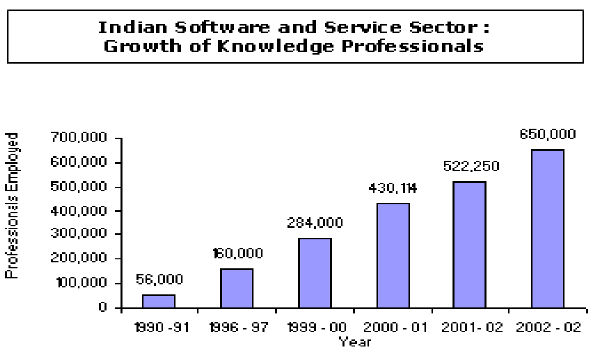
Abstract. The core research issue presented in this article is to study the factors that influence the knowledge worker's adoption of Knowledge Management System (KMS). The five-step System Dynamics research methodology was followed to design and develop the Knowledge worker adoption model. This model studies the transition of a knowledge worker from a non-user to an experienced user over a fixed time frame identified. Simulation experiments were conducted to arrive at the behavioral pattern of these knowledge workers. The analysis shows that knowledge workers respond differently as they integrate the new technology into their work pattern. The results were analyzed for the different employee categories based on their level of expertise of usageof KMS in the organization and factors such as supervision, ease of use of technology were found to affect the knowledge worker's concerns for adopting KMS in their work. The current simulation model was built using the softwareVensim® and the outcome of the study should aid administrators and policy makers to evaluate the impact ofthe identified factors on adoption of KMS.

Keywords: Knowledge worker, Knowledge Management System, System Dynamics

1. Introduction

Alavi and Leidner [1] describe KMS a class of information systems applied to managing organizational knowledge. Any organization that has a KMS in place must require individuals to develop, use and apply the organizational knowledge.These individuals are termed "Knowledge Workers" in today's knowledge economy [2] [3]. According to NASSCOM, India's apex association of Software and Service Companies, NASSCOM 2003 revealed a steep annual increase in knowledge workers hired in the Indian software and service sector from 1990 to 2002 [4].The Fig.1.shows the projection for skilled knowledge workers in IT sector alone which brings forth the need for predicting increase in demand of knowledge workers in all knowledge based organizations in other sectors.



Projection of Additional Employment in IT Sector

Year	Additional Workforce requirements
2001	90,000
2002	115,000
2003	150,000
2004	195,000
2005	250,000
2006	300,000
2007	340,000
2008	370,000

Fig. 1: NASSCOM survey results at NASSCOM 2003(Source: [4])

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A knowledge worker's concern of adopting a new technologylike KMSwhen disseminated into any intellectual marketplace such as the software sector or an IT company or any other knowledge based organization, can display a wide variety of behaviour. A number of dynamic variables play an important part in the successful adoption of KMS by the knowledge worker. It is seen that knowledge workers often may have quite a few concerns as they adopt the new technology, including factors like their individual training in technical skill sets, academic background. The more concerns they have, the more likely they are to be resistant in adoptingthe system. Thus, it becomes imperative to identify the factors that can affect the knowledge worker's adoption behaviour.

There is an inherent difficulty of testing such variables in real time scenarios mainly due to the cost of conducting such experiments and more so due to knowledge workers unwilling to share these issues. In such cases, simulating the adoption process is a viable option that will provide trainers and decision makers with methods to assess the factors that support new technology use in any organization. Hence, the research methodology applied in this paper follows the principles of System Dynamics method (SD), first introduced by J. W. Forrester in the 1960s at the Massachusetts Institute of Technology (MIT), Boston [5]. The SD approach includes Problem identification, System conceptualization, Model formulation, Simulationand validation and Policy analysis and improvement.The stock and flow modelling and simulation are performed usingVENSIM PLE® software.Simulation models generate behaviour throughsimulation.The SD process is iterative and flexible[6].

2. Objectives

The main purpose of this research article is to propose a simulation model that tests the impact of factors that affect knowledge workers' adoption of KMS. To achieve this purpose, the following objectives ahve been formulated:

- Identifying and relating variables within the system.
- Constructing the Stock and flow diagrams.
- Formulating the governing equations.
- Modeling and simulation of the Knowledge Worker Adoption Model (KWAM)

3. The Model construction

The model has been designed and developed based on the generic basic diffusion model incorporated into the KMS scenario of an organization [6] [7] [9].A knowledge worker's cycle of growth startsfrom a being a new employee with no experience in using a KMS to a trainee employee (undergoing training to use a KMS) to a new knowledge worker (trained and ready to apply his skills in using a knowledge repository like a KMS) to an experienced knowledge worker with years of experience in handling and applying KMS knowledge all treated as stock variables in the model.

The stock and flow diagram of the proposed KWAM is presented in Fig. 2. The 4 stocks are:

- New Employees: Indicating pool of employees who have just joined the organization
- Trainee employees: Indicating pool of employees who are undergoing training
- New Knowledge workers: Indicating pool of employees who have completed training
- Experienced Knowledge workers: Indicating stock of employees who have been using the technology and experienced users

3.1. The Adoption Process

All categories of knowledge workers whether they are new employees, trainees or experiencedwork in the same organization. The adoption process is about experienced workers creating awareness among non-users about the use of technology in their work. The model therefore focuses on this rate of this interaction.The variable "knowledge worker with non-user contacts" represents that pool of knowledge workers who have adopted the systemcoming into contact with employees who are non-users. Going ahead, there is a reasonable chance that this contact may result in the non-user adopting the system in future. "Adoption fraction" represents this probability of conversion."Application fraction" is the model variable that refers to the time fractionexperienced knowledge workers devote to application which could include the time they spend on doing research, publishing white papers or working on resolving their project problems [9].The variable “trainee conversions” is affected by any addition of trainee employees who complete their training period.

Apart from the variables used, this model also includes six constant values that determine the speed of transition of knowledge workersr from the training phase to gaining experience. The constant “Self-training time” represents the time required for an employee with no formal training tobecome sufficiently proficient to be a Knowledge worker and “Minimum training time”indicates the time required for a trained employee to become proficient in the technology used. It is also observed that as the experienced knowledge workerdevotesmore time to training, there is a change in the average training time which moves from self-training time, to minimum training time according to training productivity change. Fig.2. depicts the Knowledge worker adoption dynamics model.

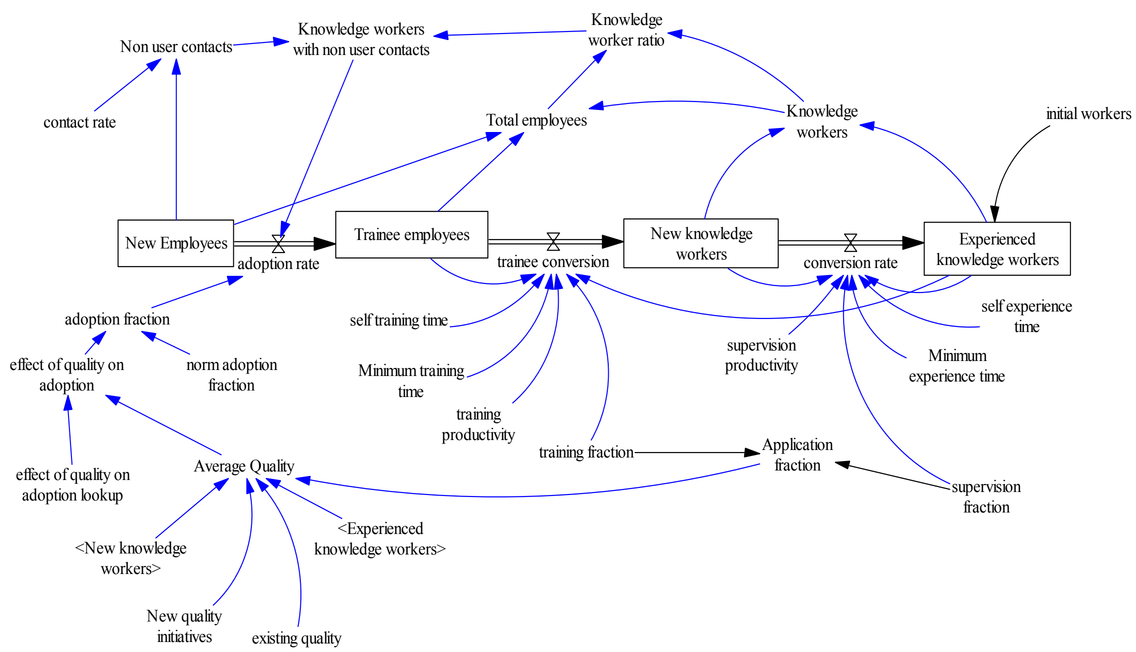

Fig. 2: Stock and flow of Knowledge worker adoption dynamics

There are causal relations between the variables of the model and these are linked in the form of equations for quantifying the simulation results. The units of variables indicated in parentheses.

Knowledge workers=Experienced knowledge workers+New knowledge workers (Units: users)
Experienced knowledge workers= INTEG (conversion rate,initial workers) (Units: users)
Trainee employees= INTEG (adoption rate-trainee conversion, 0) (Units: users)
New knowledge workers= INTEG (trainee conversion-conversion rate,0) (Units: users)

4. Analysis

4.1. Model Scope

The variables defined in the model are endogenous to the model and serve the purpose specified as per the requirements of SD model boundary identification.

4.2. Time Horizon

System dynamics may be used as a prediction tool, and helps understand the problem being studied as well as the potential decisions that may be considered. Hence the modeller must be able to design for a particular purpose outside a narrow time zone. In this case the trend of technology life span averages around 10 to 15 years, therefore the study maintains a 10 year time horizon at TIME STEP=0.125[9].

4.3. Modelling conditions and results

4.3.1. Simulation 1:Effect of change in knowledge worker adoption behaviour varying 3 factors:

- Application fraction =1, Training fraction=1 and Supervision fraction=1

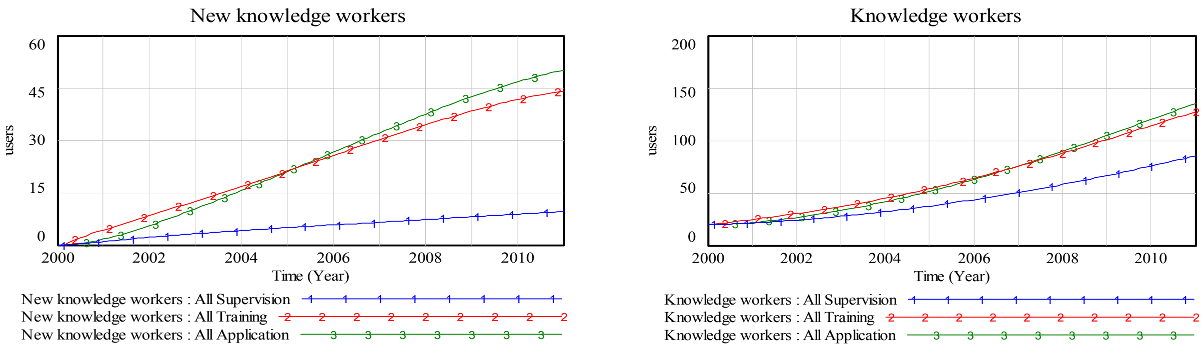

Fig. 3: Effect on New Knowledge workers and Knowledge workers

In this simulation, the behaviour of the system is experimented by adjusting the value of three factors. When application fraction =1, the knowledge worker's effort is entirely devoted to work on the job and new knowledge workers must train themselves. Setting Training fraction to 1 means all the effort is devoted training new employees while setting Supervision fraction =1 implies all effort is devoted to generating experienced knowledge workers.The governing equations are

Application fraction= INITIAL(1-supervision fraction-training fraction) (Units: Dmnl)
Supervision fraction=0 (Units: Dmnl)
Training fraction=0 (Units: Dmnl)

In case of new knowledge workers, there is a steady rise when the training and application fraction are changed. The inference could be that the new knowledge worker has undergone sufficient training to utilise the KMS and apply the same in independently resolving issues or even researching on other areas of concern. The knowledge worker pool however shows a steady rise with the right amount of training leading to self-sufficiency in knowledge to enable applying this knowledge in work. The experienced knowledge worker on the other hand, displays a gradual increase in the knowledge application curve over the training curve implying that an experienced knowledge worker makes adequate use of knowledge acquired.

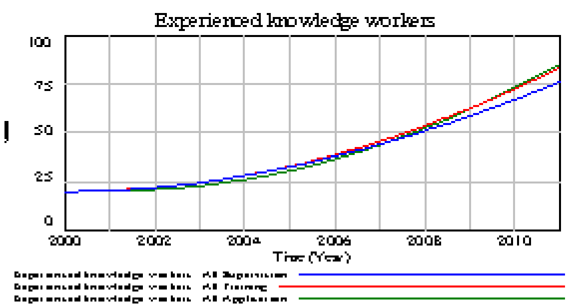

Fig. 4: Effect of Supervision, Application and Training on Experienced Knowledge workers

Fig.4. shows the trend of experienced workers (in numbers) when changes to parameters are applied (users in the graph is the dimension for the stock experienced knowledge workers)

4.3.2. Simulation 2:To study the effect on knowledge workers when:

- New quality = 0.6 (quality initiatives to 6%)
- Self-training and Minimum training time are set at half their values.
- Supervision fraction and training fraction set at 0.1 (At 10% of experienced worker's time)

Fig. 5 indicates that both ease of use and quality can have a significant impact on the speed of diffusion of a technology such as KMS in any organization.Additionally, when self-training time and Minimum training time was halved, the trend remains the same but the curvedoes show a significant increase as is the case when the supervision fraction and training fraction are balanced at 10% revealing a steady upward increase in KMS usage behaviour.

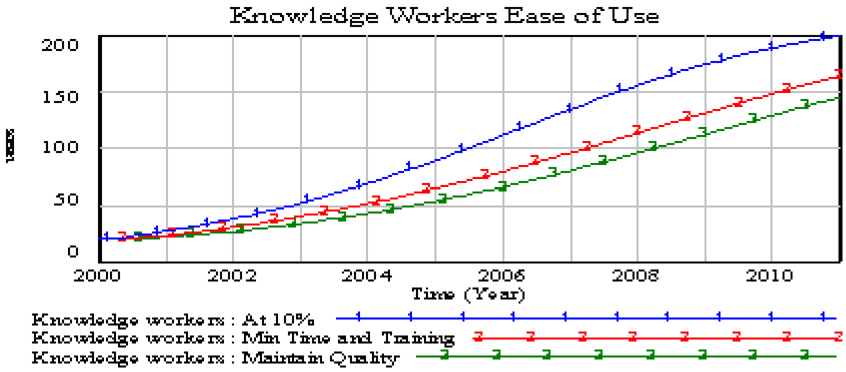

Fig.5: Effect of change in quality and self-training time on Knowledge workers

5. Conclusions and Implications

The KWAM developed and simulated in this research paper provides insight into understanding the behavioural factors that affect the knowledge worker's rate of adoption of based on training, ease of use and quality parameters. The work started with a set of written hypotheses and worked on building the KWAM.The simulation results indicate factors like supervision, training and user-friendly technology favour adoption among novice workers. Asteady rise in the number of new knowledge workers using the organizational KMS when the training and application fraction are set to a high of 1 was observed. There was a rise in adoption of KMS even with increased quality initiatives and ease of use. System dynamics provides methods for validation of the model. The model is validated using Face validity test, Dimensional consistency test and Parameter Sensitivity test. The model gives a basis for understanding reality and action to work on this understanding, however to establish more confidence, data and reality checks need to be implemented which will be worked upon as the next phase of research. Further, KM researches may also refer to this model and explore dynamic structures not identified based on specific situation mapping.

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