

Enterprise Technology Management Maturity Model and Application

LE MODELE MUR DU MANAGEMENT TECHNOLOGIQUE DE L'ENTREPRISE ET SON APPLICATION

Li Xiaoyan¹ Feng Junwen²

Abstract: In retrospect the human history, the economic development is concerned with technology. Technology is the huge force that pushes forward the economic development. In the current knowledge-economic period, technology has become an important asset in an organization, especially in an enterprise. Consequently, technology management has emerged as an issue that managers have to deal with. Therefore, this paper aims to construct a technology management maturity model to evaluate the differences of enterprises' technology management practices. An enterprise will be taken as an example to illustrate the application of this model and discuss how to support the practices at each maturity level in a certain enterprise by using this model.

Key words: technology management, maturity model, technology management process

Résumé: Dans la rétrospection de l'histoire humaine, on constate que le développement économique se rapporte toujours avec la technologie. Celle-ci est une force considérable encourageant le développement de l'économie. Dans la période actuelle de l'économie du savoir, la technologie est déjà devenue un capital important pour une organisation, en particulier pour une entreprise. En conséquence, le management de la technologie émerge comme un problème que les gérants sont obligés de résoudre. Ainsi, l'article présent vise à construire un modèle mûr du management technologique afin d'évaluer les différences de pratiques des entreprises dans ce domaine. Une entreprise sera donné comme exemple pour illustrer l'application de ce modèle et discuter comment supporter les pratiques à chaque niveau de maturité dans une certaine entreprise en appliquant ce modèle.

Mots-Clés: management technologique, modèle mûr, processus du management technologique

1. INTRODUCTION

In the knowledge-based economy, technology has become an important asset in an enterprise. It is one of the propulsions of the society development. With the development of the technology, technology management more and more infiltrates every side of society and enterprises. Because of not making good use of the technology, many corporations realized that they blundered away a great deal of commercial opportunities. Since 1990's, a lot of corporations regarded technology as their strategic asset. Thereby, technology has become the source of competition advantages for an enterprise. Currently, many enterprises have carried out technology management.

However, the effect is very different. In order to evaluate the difference of enterprises' technology management practices, it is very necessary to construct a technology management maturity model.

Based on the conception of continuous process improvement and the Capability Maturity Model (CMM) of the Software Engineering Institute (SEI), this research aims at constructing a technology management maturity model, which can be applied to most enterprises, to describe how they support the practices at each maturity level, and provide maturity paths that enterprises can follow.

¹ School of Economics and Management, Nanjing University of Science and Technology, China.

² School of Economics and Management, Nanjing University of Science and Technology, China.

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2. LITERATURE REVIEW

2.1 Technology Management

According to the studies, we define technology as “the technical means people in the enterprise use to improve their surroundings. It is also knowledge of using tools and machines to do tasks efficiently. We use technology to control the world in which we live. Technology is people using knowledge, tools, and systems to make their lives easier and better.” Generalizing the definition about “management of technology (MOT)”, there are three classifications. The first is on Management Of Technology-Concealed Advantagement, which was issued by America research committee. It is said MOT is concerning with science, engineering and management theory, through planning, exploiting and implementing, then finish the enterprise objective. This emphasizes planning. The second highlights the management of innovation and creation. The last one is said MOT is one of the management about strategy, needing the coordination of all the sections.

2.2 Maturity Model and Technology Management Maturity Model

2.2.1 Maturity Model

The Software Engineering Institute (SEI) set up the Capability Maturity Model (CMM), in this model, the software developing process was divided into five maturity levels by emphasizing the need for continuous process improvement. They designed a evolutionary path to improve the maturity of software development step by step. The source of CMM is the software process maturity framework concluded by Humphrey (1987a), in which every level has its distinctive features, and when managers are conducting software developing, it can provide references for managers to insure successful competitive performance for the enterprise.

2.2.2 Technology management maturity model

Gabor Klimko defined *Maturity Model* as “the description of an object’s developing process with time going”, if the object is technology management, that is, technology management maturity model. Different enterprises needed various technology management modes because of the different technology they have. So, there is not a technology management maturity model that is suitable for every company, but a company can develop a TMMM, which meets its own needs by using the methodology of maturity model on the basis of its own situation.

We can develop a methodology on technology management, that is, “Technology Management Maturity Model, TMMM”, enterprises can use this model to assess the effect of technology management and formulate the developing orientation of their technology management.

We propose a TMMM extending across the CMM of SEI, which suggests that technology management maturity had five stages: Default stage, Reactive stage, Aware stage, Convinced stage and Sharing stage. In this model, every level can be evaluated by three capacities of the enterprises, that is People, Process and Technology, thereby, there are Key Result Areas (KRA) resulted from the capacities in every level.

The methodology of evaluating maturity in these studies is all based on the opinion of enabler facts. We construct a technology management maturity model from the perspective of technology management process, and integrate technology management enablers into Enablers, which are just instruments or methods for accomplishing each technology management process objective on every maturity level. Therefore, we draw a conclusion that we can distinguish technology management from the perspective of technology management process.

3. CONSTRUCTING THE TMMM

There are three components in the proposed model: maturity levels, technology management process, and technology management enablers. Based on the literature review and the capability maturity model (CMM) of SEI, we conclude our Technology Management Maturity Model, in which the technology management process of enterprises’ is divided into five maturity levels and technology management enablers are integrated into.

3.1 Maturity levels

This study is mainly based on the capability maturity model (CMM) of SEI, we divide technology management maturity model into five maturity levels, and each level represents a step of technology management process improvement. The five maturity levels are shown in figure 1:

Every maturity level has its objectives and specific management practices to guarantee the objectives’ accomplishment. Objective can be divided into ordinary objective and specific objective. Ordinary objective is the aim that should be achieved in technology management process, and specific objective is the aim that should reach in technology management sub-processes. Correspondingly, management practice can be divided into ordinary management practice and specific management practice, we can attain to ordinary objective by using ordinary management practice and achieve specific objective through specific management practice. An enterprise must accomplish the objective of a certain level when it wants to reach this maturity level. Meanwhile, we can evaluate the enterprises’ technology management maturity by examining the management

practices they have achieved.

3.2 Technology management process

Technology management process can be divided into sub-processes; the subdivision of technology management process can help managers know better about their enterprises' practice, the differences between each sub-process maturity. At the same time, the

subdivision of technology management process is conducive for managers to find out which section in technology management process should be improved and formulate corresponding measures. This model divides technology management process into four main sub-processes: technology strategy, technology R&D, technology innovation, high and new technology application.

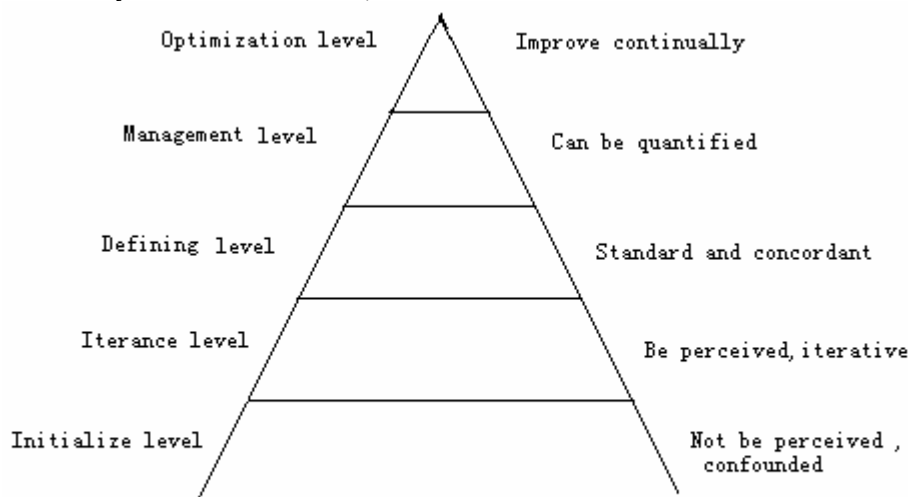


Figure 1 Technology management maturity level

3.3 Technology Management Enablers

This study suggests that technology management enablers are culture, structure, science and technology. Science and technology is the software and hardware facilities concerning computer. Culture is the knowledge, including hypothesis, value conception, belief and meaning system, sharing with enterprise members. Structure is composed of formal regulations, assignment and authority. These three components support the technology management process from different aspects, and promote the enterprises' technology management together.

3.4 Constructing the model

We can build the frame of the technology management maturity model based on the three components. With integrating others' work-studies, we define the objectives that each maturity level should attain to, management practices and management enablers which enterprises should possess, and construct the technology management maturity model shown in table 1.

4. MODEL APPLICATION

Considering the applicability of this theory, this text chooses an enterprise as research target and do a case

study.

By investigating the enterprise and collecting correlative second hand data, we can educe the actuality of technology management of the enterprise, including the management practice and the enabler of this enterprise.

According to management practice of the enterprise, it can be judged which level that the technology management maturity of it is. The general management practice and specific management practice of the enterprise is as table 2 and table 3.

It is obvious that the maturity of four technology management sub-process of the enterprise has reached the third level, but generally, it is still at the second level.

According to the judgment of technology management maturity of the enterprise, and combining the enabler conditions of it, which we have collected, we make suggestions as follow:

First, according to the model, if the enterprise wants to reach the third technology management maturity level, it must establish the special unit to take charge of technology management. In the research and development department, the branch of manufacture and the marketing department, the skeleton members should be selected and compose an innovative attacking group. The staffs of the different knowledge background gather in the same place, exchange the

knowledge experience and propose respective innovative mentality. They discuss together and form the plan about the research and development, the manufacture, the marketing flow. The superiority and the strength of various departments' various knowledge technology can be integrated to solve the problem. Thus the new product can be consummated; unceasingly

knowledge technology ability can be richened and developed. By this way, the new knowledge technology link way can be discovered and completed in the technological innovation performance. Correspondingly the innovation success ratio and the knowledge technology link validity can be enhanced, too.

Table 2. The general goal and general management practice of the enterprise

Level	General goal	General management practice	Achieve or not
First	---	---	---
Second	Get on to the importance of technology management	Define the concept of technology management, discover the problem, opportunity and latency value of technology management	O
Third	Systematical technology management support	Establish the special unit take charge of technology management	X
		Input resource	O
Fourth	Quantify the control of technology management process	Stabilize the result of sub-process	X
Fifth	Continually improve technology management process	Do improve technology management process continually	X
		Correct the blunder	X

Table 3 The specific management practice that the enterprise has achieved at every technology management sub-process

Level	Specific goal	Management process			
		Strategy	R&D	Innovation	Application
First	---	---			
Second	The success of technology management in given area	Make the technology into document	Customer is in the center of it	Don't restrain the originality of employee	Technology application not in work process
		O	O	O	O
Third	Establish standard and concordant technology management sub-process	Makeup the strategy about technology	Definite the research persons and superior instruments	Establish formal technology innovation channel	Divide the work
		O	O	O	O
		Establish formal technology tactic mechanism	Education and training	Patents management mechanism	Create conditions to support technology application
		O	O	O	O
		---	---	Security of technology patents	---
Forth	Set the indexes and goal that can be quantified of knowledge management sub-process	Set the goal that can be quantified of technology strategy process	Set the goal that can be quantified of technology R&D process	Set the goal that can be quantified of technology innovation process	Set the goal that can be quantified of technology application process
		O	O	O	O
		×	×	×	×
Fifth	---	---			

Second, it will lead to attach importance to obvious technology and neglect self-innovation that the enterprise chooses information technology as the

solution to technology management. Many researches have pointed out that establishing practice community can help to do self-innovation technology management,

so this research suggest that the enterprise should establish innovation community to manage self-innovation technology. In the production activity, the time is short of which the innovator obtains the correlation product, the knowledge technical information. The cost is low. Accordingly the correlative knowledge- technology and the most recent development direction of the market may be grasped promptly. It is may also be adjusted according to own demanding promptly. A phenomenon is demonstrated that the technological management innovation has been promoted under one kind of interactive study effect, as well as knowledge technology reorganization can be promoted and created from the organization process and the mechanism.

5. CONCLUSION

In the current time, technology management has become one of the hot spots in academe, but there has not been a popular method by then. Different enterprises choose the different methods. Therefore, this research puts forward a technology management maturity model, which is all-purpose and bases on the correlative theory to show the difference of technology management level of different organization. By using this model, manager can have a general view of technology management of the enterprise, then, find out which part of technology management should be strengthened, and offer a way to improve technology management process.

Table 1 Technology management maturity model

Level	Goal	Management practice			
		Strategy	R&D	Innovation	Application
First	---	---			
Second	Get on to the importance of technology management	Define the concept of technology management, discover the problem, opportunity and latent value of technology management			
	The success of technology management in specific area	• Choose technology that the enterprise can do	Customer+ ¹ is in the center of it	Don't restrain the originality of employee	Technology application not in work process
Enabler	Science and technology	Internet; Intranet; Network between corporations			
		•subdivide the commercial strategy •Understand the technical base and expectation of the superior strategy base	•Electronic notice-board •Document edit software •Data base •Brain and support software •Chatting room	•Electronic notice-board •Video frequency meeting •software buddle •E-mail •Electronic practice community	•Interface design software
	Structure+ ²	Practice community			
Third	Systematical technology management support	•Establish the special unit to take charge of technology management •Input resource			

To be Continue

Continued

Level	Goal	Management practice			
		Strategy	R&D	Innovation	Application
Third	Systematical technology management support	<ul style="list-style-type: none"> ·Establish the special unit to take charge of technology management ·Input resource 			
	Establish standard and concordant technology management sub-process	<ul style="list-style-type: none"> ·Make up the strategy about technology ·put technology into the standard of the production process 	<ul style="list-style-type: none"> ·outfit with the research persons and superior instruments 	<ul style="list-style-type: none"> ·Establish the innovation model ·Education and training ·pay attention to the patents and put them into productions 	<ul style="list-style-type: none"> ·Create conditions to support technology application ·Divide the work
Enabler	Science and technology	Company web site TMS			
		<ul style="list-style-type: none"> ·Technology detection tool ·Idea assistant implement ·Conception reply tool ·Case ratiocination system ·Patten simulation ·Concurrence filtration system ·manpower wit ·business wit 	<ul style="list-style-type: none"> ·Documentation search ·manpower and physical resources ·File management system ·case ratiocination system ·FAQ · R&D process system · Expert system 	<ul style="list-style-type: none"> · Search engine ·Technology list ·Technology map · Wit agent · Content original search · Learning system online · expert Yellow Page 	<ul style="list-style-type: none"> · Expert system · Work process system · Prompt analysis online · Decision support system · Wit agent

To be Continue

Level	Goal	Management practice			
		Strategy ³	R&D ³	Innovation	Application
Enabler	Structure	Special unit for technology management Case team Compressed enterprise structure			
		•Consultation management unit	•Research unit ³	•Expert training room •Regular pro-seminar	•Functionality unit
Forth	Set the indexes and goal that can be quantified of technology management sub-process	Set the goal that can be quantified of technology creation process	Set the goal that can be quantified of technology R&D process	Set the goal that can be quantified of technology innovation process	Set the goal that can be quantified of technology application process
	Quantify the control of technology management process	Stabilize the result of sub-process			
Enabler	Structure	Audit unit			
Fifth	Continually improve technology management process	Do improve technology management process continually Correct the blunder			
Enabler	Structure	Research unit Decision-making unit			

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THE AUTHORS

Li Xiaoyan, School of Economics and Management, Nanjing University of Science and Technology, 210094, P. R. China.

E-mail: lixiaoyansw@yahoo.com.cn

Feng Junwen, School of Economics and Management, Nanjing University of Science and Technology, 210094, P. R. China.