Study on the Group Cooperative Innovation Based on WEB2.0

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Abstract—**Under the circumstance of WEB2.0, staff, supply chain users and the public take effective part in the innovative process of the enterprise by adopting such online interactive tools as the blog, Wiki and RSS, which will complete the cooperative innovation among the enterprise, staff, supply chain users and the public. The group cooperative innovation will experience the knowledge creative process of the users' implicit, explicit and mass knowledge. Based on the theory of TRIZ, this essay establishes the group cooperative innovation system from the three aspects of knowledge resource, noumenal and user domains and then puts forward the specific samples and models supported by explaining the cases of IBM and DELL[1].**

Index Terms—**WEB2.0;TRIZ; group cooperative innovation; knowledge creation**

I. INTRODUCTION

The increasing keen competition requires enterprises to enhance the innovation efficiency by mining technology breakthroughs and finding out the market demands. The increase of innovation efficiency needs a wider range of people to participate the creation. Therefore, it's a inexorable trend to carry out the group cooperative innovation. For instance, "i-Mart" performed by P&G fully showed the real value of the group cooperative innovation.

The group cooperative innovation means the group related to the enterprise will take part in the creative process by effective communication and cooperation, promoting the creative activities and reducing the innovative risks by finding out the technology breakthroughs and market demands from a wider range.

The group cooperative innovation plays a great important role in the innovation of enterprises. The key to reach the effective group cooperative innovation is the interactive communications among the groups. Before the appearance of WEB2.0, the lack of communication modes blocked the channel to group cooperative innovation. With the development of WEB2.0, the application of communication software centered on Wiki, Tag, Dig, Blog and SNS which have the features of integration, coordination, self-organization and openness provides the group cooperative innovation with a simple,

convenient, inexpensive and interactive mode. Of course, researchers have researched the relative problems.

Christopher (2001) thought that the innovation inside enterprises is closed and detrimental to the spread of knowledge. Meanwhile, he proved the knowledge innovative spillover and put forward the cooperation beneficial to the knowledge innovation from the point of supply chain.

Xu Qinrui (2003) put forward staff innovation by analyzing total innovation management. He thought all staff should participate the creative activities and proposed establishing staff innovative groups.

Chesbrough (2005) thought enterprises ought to obtain creative information outside as well as inside and proposed the concept of openness innovation compared with the closed one.

Robert (2005) raised the concept of mass collaboration which was the new thing of internet and was non-organization form and non-power relation. The power of mass collaboration has a great impact on the development of industry.

Peter (2006) put forward that enterprise innovation need to build collaborative innovation networks after analyzing the process of innovation. The collaborative innovation network is a self-organization formed under the circumstance of network. Members among the organization can communicate freely and achieve the collaborative innovation by sharing ideas, information and achievements.

Zhao Fuzeng (2009) raised the concept of mass collaborative innovation on the basis of mass collaboration. He thought it was driven by internet and applied to the fields of enterprise innovation. And he explained it from the four aspects as follows: widening creative resources, commenting creative information, multiple majors merge and flexible organization form.

Based on the Wiki model, Tang Ting (2006) analyzed the establishment of group creative knowledge by using Brooks Equation and pointed out information consumption is the precondition of knowledge innovation. He also analyzed the filter model during the processes of knowledge perfection and improvement and then proposed building message trace system to renew knowledge.

Deng Shengli (2010) studied on the knowledge innovation process and mechanism based on group interactive learning under the circumstance of Web 2.0.

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He believed the group knowledge innovative system and achievements are from internet structure. Therefore perfect internet structure enables the group to have the expedite information and knowledge flowing channel, to stimulate group collaborative innovation, to raise the efficiency and success of innovation and to keep the motivation of continuous group knowledge innovation. Setting up virtual group knowledge innovation circumstance is the effective way to stimulate knowledge innovation. He built a group interactive condition in connection with the knowledge innovative users by sharing the users' information records, finding and recommending the users' interests and establishing hobby groups among the users.

Lykovrentzou (2010) studied the Wiki of self-organization form and analyzed the spiral increasing model of the personalized, internal, external and socialized knowledge.

The existing documents focused on the following two respects: one is putting forward such concepts of collaborative innovation as closed innovation, open innovation, staff innovation, mass collaboration, collaborative innovation networks and mass collaborative innovation. The first three concepts are mainly about the internal and external collaborative innovation, not emphasizing the function of internet while the latter three concepts emphasize the function of internet, particularly web 2.0, on which collaborative innovation is being discussed but the particularity of staff and supply chain users has been neglected. The other is putting forward the spiral increasing model of the knowledge by analyzing the establishment and model of group innovative knowledge under the WEB2.0. which didn't make integrated establishment of group innovative methods.

According to the existing documents and taking WEB 2.0 into consideration, this essay analyzes the consistency and particularity of collaborative innovation among staff, supply chain users and the public and then puts forward the new concept of group cooperation innovation. This article also analyzes the finding mechanism of group cooperation innovative knowledge based on Brooks Equation. At last, based on the TRIZ theory, this passage builds the new group cooperation innovation system, raises the specific examples and model supported by explaining the cases of IBM and DELL.

II. Group Cooperation Innovation Forms

Among the operation of enterprises, the related groups cover staff, supply chain users and the public. [6] Therefore, group cooperation innovation means the cooperation among those three groups, i.e. the collaboration among internal staff, between the enterprise and users, between the enterprise and the public.

A. Cooperation Innovation among Internal Staff

To figure he cooperation innovation among internal staff is involved in the flexible communication and cooperation among internal staff. Firstly, internal employees express their own ideas and innovation freely based on internet and online tools which will enlarge the innovative information resources covering market information as well as technology. Secondly, all employees can discuss the information to filter and evaluate them. Thirdly, on the flattened online platform, all employees can get together freely in accordance with their own interests without the limit of departments or specific jobs, which breaks the boundary of departments and fields and then organizes new organizations. Lastly, free cooperation among employees of different majors and professions improves the efficiency of innovation by "cross pollination".

B. Cooperation Innovation between Enterprise and Users

Under the circumstance of internet platform, particularly WEB2.0, the enterprise may get feedback and suggestions to product development from the users with the tools of blog, wiki, RSS and center forums by setting up online lab, online center, adobe lab, google labs, Microsoft live lab, which promotes the online discussion and cooperation among users. The principle of WEB 2.0 is a fever beta version which makes sure the continuous interaction between enterprise and users. Compared with the cooperation innovation among internal staff, the group cooperation innovation between enterprise and users focuses on obtaining information from the end-users. The information from end-users will make new product match with the market demand, reducing the risks of new product effectively. Meanwhile, the users from upstream supply chain will not only supply information demand but offer creative solutions to technology problems during their participation in group cooperation innovation.

C. Cooperation Innovation between Enterprise and the Public

Under the circumstance of WEB2.0, the global public may take part in the innovation process according to their interests and specialities. The way of this group cooperation innovation will solve the enterprise's innovation problems by gathering the wisdoms from global public. Crowd sourcing is the typical form.[10] It means that the enterprise outsources its assignments to mass public on basis of willingness. During the crowd sourcing, the enterprise collects ideas or solutions in the world on the platform of internet and gathers public wisdom from the global people with different backgrounds. In this way can it create excellent innovation or originality, promoting the innovation activities, improving innovation performance and reducing innovation risks.

The way of public cooperation innovation is mainly to solve technology problems because it can learn and absorb the knowledge from outside. The way of cooperation innovation among supply chain users is mainly to solve market demand. The way of cooperation innovation among internal staff can promote the employees' innovation potential to achieve entire staff innovation which is shown as in fig.1.

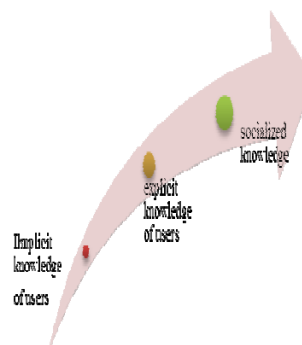Fig. 1 Forms of Group Cooperation Innovation

Fig. 2 The Knowledge Innovation Process of Group Cooperation

III. MECHANISM OF GROUP COOPERATION INNOVATION

The nature of group cooperation innovation mechanism is the establishment of group cooperation innovation knowledge and the conversion process of implicit knowledge to explicit knowledge and then to mass knowledge. The vertical flow between implicit and explicit knowledge, the lateral flow among different subjects and the interaction between them finally come into spiral action. The group knowledge innovation is the result of the continuous interaction between implicit and explicit knowledge. [9].

A. Knowledge Innovation Process

WEB2.0 provides users with a complete new platform of group cooperation innovation, under which the users can express, share and interact knowledge by interaction, cooperation and inspiration to inspire the power of group wisdom to filter, analyze, integrate and externalize the implicit knowledge and to absorb and to interact innovation knowledge combined with explicit knowledge. [8]

Firstly, from the point view of the users' activities, the process of knowledge communication and share includes the activities of converging, passing and understanding knowledge.

Secondly, from the point view of knowledge transformed process, there is the reciprocal transformation between implicit and explicit knowledge during the process of group interaction. New knowledge comes from the interaction among different types of knowledge and various persons with different abilities. By using internet, members play different roles in the internet society and own different knowledge to achieve knowledge's added value through a series of innovative activities. The two forms of knowledge innovation, group activity and knowledge transformation will promote mutually, i.e., there is socialization, externalization, combination and internalization in the process of members' gathering, knowledge transformation and understanding, which will reach the knowledge innovation which is shown as in fig.2.

B. Knowledge Innovation Equation

Under the circumstance of WEB2.0, after the individual—an information publisher about source publishes the knowledge online, the related group—information receiver about sink will not only consume the source but rearrange the knowledge according to their own innovation, and then republish the amended knowledge only. Individual knowledge handled by group information will be transformed into new one. Therefore, the active process of individual and group knowledge innovation will promote the technical innovation. [8]

Creating knowledge needs to absorb information which is information consumption behavior. Information is the latest response to the change of various things and reproduction after being passed. That the individual publishes his own knowledge online is just adding a piece of information on internet which can't be called knowledge. It is necessary to process the information deeply to create knowledge, which proves the correctness of Brooks Equation. [7]

Brooks Equation is $K(S)+\triangle I=K(S+\triangle S)$, which means the absorption of information $\triangle I$ makes the structure $K(S)$ change and then produces a new knowledge structure. $K(S+\triangle S)$ covers new information products—innovative knowledge. On the basis of the existing knowledge $K(S)$, information creators will possess, understand, analyze, absorb and recreate the information $\triangle I$ published by group to produce new information product among the whole internet. In view of whole system, the individual is not only an information consumer but a creator of knowledge during the process of creation which is shown as in fig.3.

$K(S)$, $\triangle I$, $K(S+\triangle S)$ express the meanings of Brooks Equation. $K_1 (S)$ is the knowledge of participant 1; $\triangle I_1$ is the information absorbed; $K_1(S+\triangle S)$ is the innovative knowledge after the process of rational information consumption.

On the basis of the knowledge $K_2(S)$, participant 2 analyzes rationally $K_1(S+\triangle S)$ through his own thoughts and skills and then reflects the information $\triangle I_2$ he needs.

Other participants also experience the same process. In this way will knowledge be renewed and form group knowledge innovation.

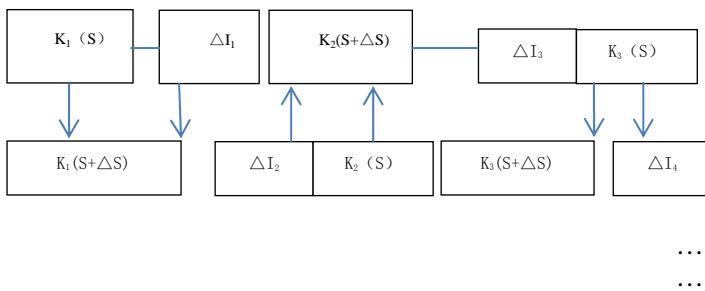Fig. 3 Equation of Group Cooperation Knowledge Innovation

IV. CONSTRUCTION OF GROUP COOPERATION INNOVATION SYSTEM BASED ON TRIZ

The group cooperation innovation system based on WEB2.0 is innovative knowledge management system abiding by the theory of TRIZ. By analyzing about 2,500,000 patents of invention from the patent database in the world, TRIZ concluded the principles of solving technical problems when human being was inventing and then established methodology system covering various methods and instruments of reaching technical innovation, whose nature is a knowledge management system including the three aspects of knowledge resource, noumenal and user domains.[11] According to TRIZ, describing the process of group cooperation innovation as a problem of finding innovative knowledge process, the establishment of group cooperation innovation system based on WEB2.0 from the three aspects of knowledge resource, noumenal and user domains is shown as in fig.4.

A. Knowledge Resource Domain

The knowledge can be gained by grabbing automatically and the model of blog. The obtained knowledge has no formal knowledge expression but can be expressed formally by the model of Wiki based on metaknowledge which describes the knowledge of contents, structures and characteristics. Each type of metaknowledge guarantees the accordance and particularity of knowledge expression by the three levels of core layer, extension layer and user-defined layer. Core layer is the main idea of the knowledge describing such characteristics as topic, topic sentences and so on; extension layer provides the definition ability for specific metaknowledge and is the extension of system predefinition to core layer; user-defined layer contains the ability of user-defining metaknowledge.

Digg can locate the instructive and quality knowledge quickly. Digg is a website to comment on and vote for online articles. In digg website, the importance of online speech will come from the comments of e-friends. So the model of digg can help evaluate and filter the knowledge. In the TRIZ system, the evaluating educator includes automatic evaluation like number of visits and downloads intentional evaluation like scoring, recommending, collecting, commenting and citing the knowledge, the refining of knowledge through the model of Wiki and the edition of collecting knowledge elements.

Wiki［9,12］is a writing tool supporting multi-cooperation. Wiki which has the particularity of supporting uniform knowledge structure, version management and content opening helps establish the knowledge share.

Tag, known as folksonomy, means the classified vocabulary formed by tagging the information resources with any words. The user may add several labels to knowledge based on noumenon. The addition of labels means adding a flexible semantic classification. For instance, if certain knowledge has been added the noumenon tag of pre-retroaction, this knowledge would be linked to the noumenon under the noumenon map.

By the model of RSS and customized by users, the system will automatically recommend the high reputable knowledge resources. Semantic searching for the knowledge based on noumenon, the knowledge database will track and record the noumenon of TRIZ and the use situation of knowledge resource cases, which will assist professional persons to do knowledge innovation and to perfect knowledge internet by digging the mass data.

B. User Domain

Through the use and construction of platform in which has the activities of tagging, knowledge evaluation and building knowledge and noumenon together, designers, experts, customers and other relative persons will be gathered according to topics, processes and hobbies. In this way can users be convenient to cooperate and develop cooperation innovation and finally come to a social network. Each individual is the main carrier of implicit knowledge in innovative designs and this social network is an implicit knowledge network.

This platform will follow the action and function of the users participating in the establishment and maintenance during the whole process and then the database of users' action and function will be come into being, on which the participation and contribution degree of users can be calculated and then the user's authority and weighing can be determined which may inspire the user to establish and use TRIZ knowledge network and eventually come to a self-organization mechanism in building TRIZ knowledge network.

C. Noumenon Conceptual Domain

Dou to the features of great workload and dynamic change in noumenon construction, it is better to build noumenon by the model of Wiki and Digg. To the problems of conceptualization isomerism and expression isomerism arising in users' construction of noumenon, meta ontology can be adopted to guarantee the accordance of noumenon.
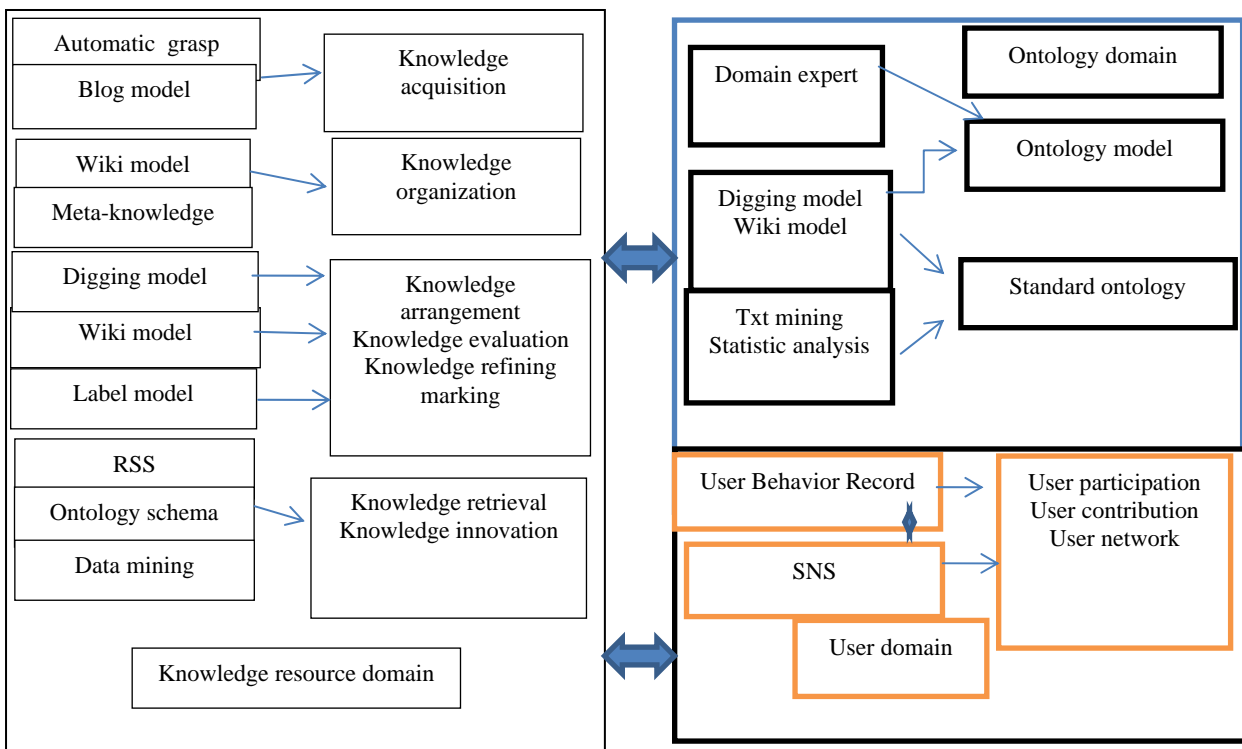
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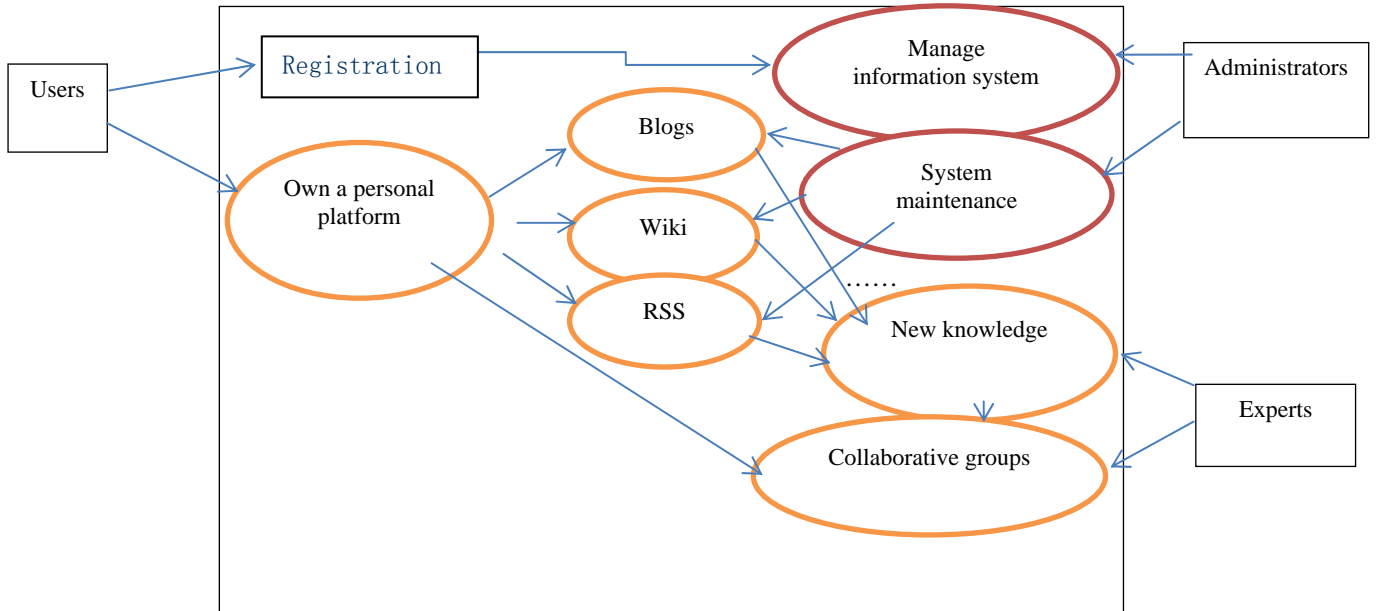Fig. 4 Group Collaborative Innovation System Based on TRIZ

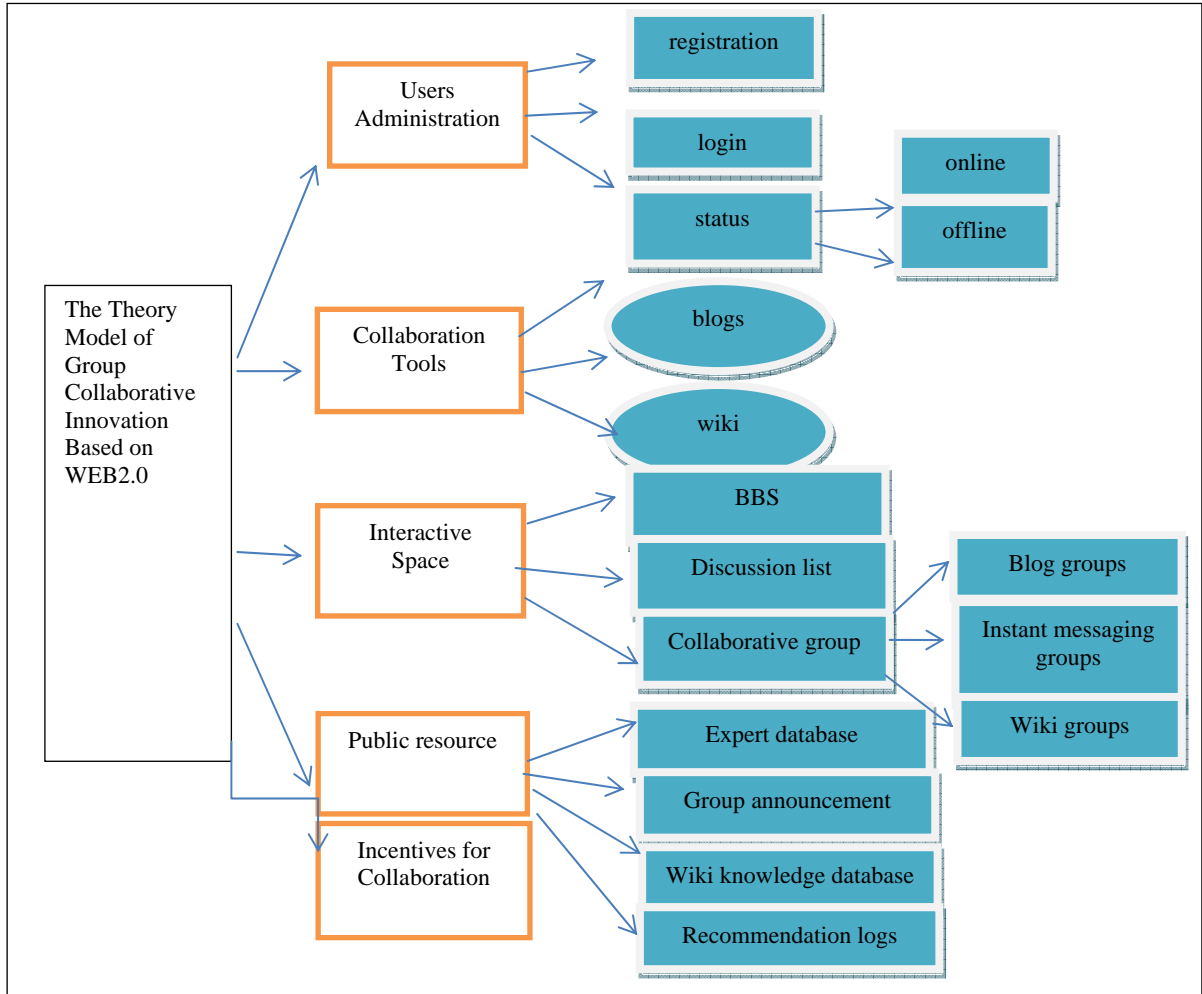Fig. 5 The Use Case Model of Group Collaborative Innovation

Fig. 6 The Theory Model of Group Collaborative Innovation Based on WEB2.0
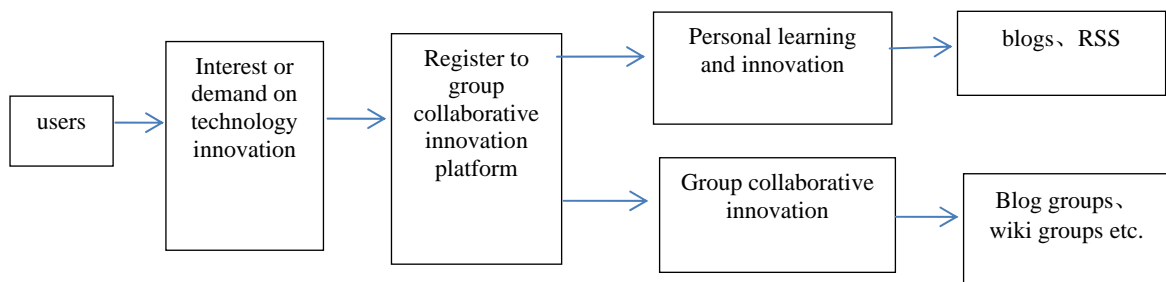

Fig. 7 the Behavior Model of Group Collaborative Innovation Based on Web2.0
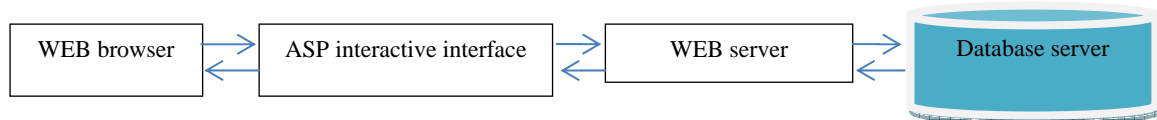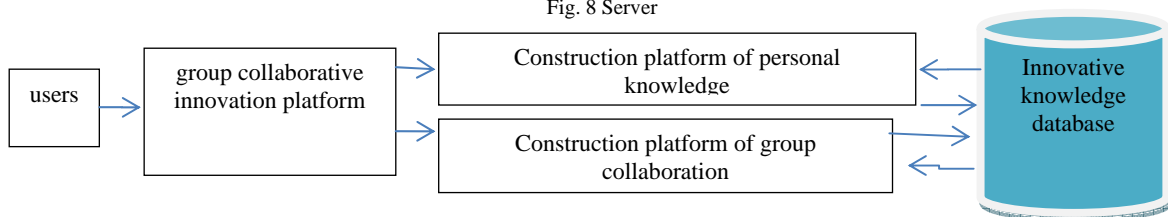

Fig. 8 Server

Fig. 9 WEB Interface Edge

V. THE SPECIFIC USER CASE AND THE IMPLEMENTATION OF MODELS.

A. The Use Case

Based on the thought of TRIZ, it mainly includes the participation of various users in the Knowledge Resource Domain, knowledge construction in the Ontology Domain, and information statistic in the User Domain. Therefore, we construct the User Model as shown in fig.5.

B The Theory Model

With the analysis of the use case, we build the theory model of group collaborative innovation based on web2.0, just as what fig. 6 shows.

C The Behavior Model.

With the description of the theory model, we can establish the behavior model of group collaborative innovation based on Web2.0, exactly as what fig. 7 shows.

D The System Model.(fig.8. fig.9)

VI. EXAMPLE ANALYSIS

In 2001, IBM set up its own group cooperation innovation platform – Innovation Jam on which employees could discuss extemporaneously and state their views about enterprise's innovative opportunities and threats which cover the perfection of organization structure as well as telling market opportunity and technical innovation. Then managers picked out excellent innovation plan and experts, technicians, market managers and employees with interest made up an online cooperation innovation group who would optimize and perfect the chosen excellent plan. The optimized plan would be tested by technical innovation group. After testing, the final result would be passed on relative users by blog and Wiki to collect the feedback of users and then completed the innovation plan. Meanwhile, the innovative problems involved in the whole process would be analyzed and collected to form fresh knowledge which will be introduced into TRIZ knowledge database in order to complete the group cooperation innovation based on WEB2.0

Currently, IBM has already a database for thousands of employees on the basis of self-edition by staff. The database includes each employee's hobbies, speciality, etc and it is open to every employee who can contact any colleague to cooperate through the tool of WEB2.0. [18]

In 2002, Dell established Dell Online Center covering almost all WEB2.0 elements as ideastom, directdell, dellforums, studiodell, etc. Ideastorm is product innovation communication platform which encourages users to offer originality about Dell's products and services and welcomes users to discuss and vote for these ideas; DirectDell is a blog written mainly by staff which aims at listening to users' advice and increasing the communication and can be regarded as online extension of Dell's direct selling model; DellForums provide products with technical support in the form of forum. Due to the feature of online centre, users offer technical assistance in most cases similar to the online knowledge question and answer center; StudioDell aims at communicating with users or deepening the users' product experience through a more intuitive way. In addition, Dell also established TechCenter offering further technical services by using the function of Twitter and setting up innovative platform on SecondLife to attract users to participate. [19]

InnoCentive, the global third party mass-rent platform developed and built in 2001, was a typical group cooperation innovation third party platform based on WEB2.0. This platform, involved in such fields as chemistry, physics, life science, mathematics, computer science, engineering design and business development, gathered 145,000 professionals and amateurs. The seeker who needs innovation firstly issues questions online and participants from all over the world register online and then propose solutions to the questions. According to statistics, the problem solving rate reached 30% on the platform which increased innovative efficiency greatly. [20]

VII. CONCLUSIONS AND EXPECTATION

Under the circumstance of WEB2.0, group cooperation innovation becomes verified and efficient. By using interactive tools of blog, Wiki, RSS based on WEB2.0, internal staff, users and the public transform implicit personal knowledge into explicit knowledge and then into socialization knowledge by group cooperation innovation, helping enterprise reach effective innovation. On the basis of TRIZ theory, group cooperation innovation system can be established from knowledge resource, noumenon and user domains which ensure to dig innovative opportunities and effects, meanwhile which reach the dynamic refreshment of TRIZ database.

Group cooperation innovation platform can be accomplished by enterprise itself like IBM, DELL, and also can be completed by third party like various mass-rent platforms. This essay didn't research on which one is better to develop group cooperation innovation, which will be studied further.

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