Introducing Cooperative Education in Practical Curriculum Change: A Case Study

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Abstract Developers occupy one of the key positions in the development of new products. Therefore technology policy should identify developers as a key actor or important target group. Although there, are numerous sorts of institutions involved in training and education, research and development, and the transfer of technology trying to intensify contacts between science and industry. Institutions should be the supplier of developers to firms, at the same time, the place of cooperative education to universities. This paper introduces the theoretical foundations of cooperative education and innovation process, and then by the case of practical curriculum, clarifies the question "How to actualize cooperative education". In the end, some suggestions are provided for policy-makers, who are engaged in shaping the interface between science and industry.

Key words Cooperative education; Innovation process; Institutes; Developer

1 Introduction

Although many countries are not lacking in scientific and technical knowledge, a deficit does exist in the transfer of this knowledge into industrial practice: the results of research and development could be implemented quicker and more efficiently into marketable output and be used to benefit the economy. Thus, in many countries an optimization of the interface between science and economy has become one of the most important guidelines of technology policy(Song and Jeffrey, 2006). The objective is to create systems able to function as a link between industry and public institutions that are involved in research and development as well as continuing education and training in order to boost innovation within the economy.

Whereas the intention is clearly formulated, the question of how to solve the task remains unclear because previous initiatives under the title "technology transfer" have frequently failed to achieve the desired success. In this context, studies relating to scientific innovation indicate that the policy would benefit if it did not consider the transfer of technology as simply buying and selling components of technology. It is more appropriate to assume cooperation and communication between the actors involved. This is particularly true if technical innovation is induced by problems of industrial practice, i.e. they start with a market related problem and can at best be indirectly attributed to scientific impulses.

In such a perspective the developer's networks play an important role in the innovation process. The professional relationships of engineers, designers, technicians and developers who deal every day with technical problems such as improving existing products and procedures or developing new ones are decisive for swift and future-driven problem-solving. Although information on the networks of developers would by important for the formulation of an efficient technology policy, the respective knowledge is relatively sparse.

By focusing on the role of developers, who in fact are in charge with the technical part of innovation, we do not contest the importance of other factors within the innovation process. This holds especially for people in management and marketing who are responsible for the firm's innovative processes and the respective market success of its products. However, we strongly felt the need to train our students to be the developer, as well as the technology transfer and problem solver.

In the following, we will introduce the theoretical foundations of cooperative education and then clarify the question "How to actualize cooperative education". In section 4, we will use a case to illustrate. And at last, we formulate some suggestions for policy-makers, who are engaged in shaping the interface between science and industry.

2 Cooperative Education and Innovation Process

The theory that education is likely to be more effective if it gives students opportunities to practice what they are trying to learn applies not only to education for work. Mathematics, for example, is best learned by students constructing their own proofs and demonstrations. The common sense of learning by doing has been upheld by philosophers and more recently by cognitive scientists. This argument is linked to a view of education as preparation for active problem solving and participation in the world. Although learning by doing has most often been a feature of vocational and professional education, it is now argued that all knowledge, including the sciences and humanities, is created, defined, and transmitted by communities of practice (Linn et al., 2004).

The early studies of the innovation process, conducted mostly in the 1950s and 1960s, proposed a simple unitary progression of phases or stages in the development of products. These models were presented as simple linear sequential events focused on research and development (R&D) activities. The products resulting from these activities were imposed on to the market (Bales and Strodtbeck, 1951; Lippitt et al., 1958; March and Simon, 1958). In their review of managing innovation and change process, (Schroeder et al. 1986) provided a chronological summary of the innovation process and concluded that early developments of the innovation model were inadequate for dealing with the complexities apparent in the phase process. They called for a re-examination of the findings of these previous studies by proposing a more dynamic approach that was validated with more rigorous empirical evidence.

During this period, economic growth came mainly from new industrial sectors where the dominant corporate strategy emphasized R&D and manufacturing as key elements in a linear process of innovation performance. Managers of major companies accepted the view that a new product or process was the result of discoveries in basic science. Therefore, possible commercial applications were brought to the attention of organizations by research staff (Herminia, 1993; Howell, 1990). Hence, this explained the significance researchers placed on drawing individual attributes as an important determinant of innovation for organizational success.

The organizational approach ostensibly evolved in the 1970s as a new dimension in innovation research. It was developed to address the deficiencies of explaining innovation in terms of individual behavior. Research evolved around the structural parameters of organizations and the importance of organizational functionality within the business environment. This view of innovation focused on both structural functionalism and contingency theory, with an attempt made towards explaining how organizational structure constrained or propelled the innovation process. This body of literature introduced the linkage of technology push and market pull models. It reveals the sequence of events in the innovation process and the way innovation is linked to technological developments and market forces. It also shows the role of functional departments in the organization and ways of converting information into ideas, utilizing knowledge towards product development and delivery of products into the marketplace. For example, models presented by (Rothwell and Zegveld1985) show the innovation process as a sequence of events linked to organizational functionality where each function holds a distinctive role in the contribution to innovation success.

An emerging body of literature suggests an integrated approach to the innovation process, reflecting the synthesis of both individual behavior parameters as well as structural variables in the organization. The innovation process is looked upon as a complex stream of communication linking the structural functions of the organization and knowledge creation. Knowledge is transferred from R&D through manufacturing, marketing and service through internal linkages, and moves inside and outside the organization through external linkages. Initiation of the innovation process is thus dependent on three main sources: organization capabilities, science and technology developments, and the market place. Much of the research work has evolved from the shortcoming of previous studies to provide a reconciliation of organizational behavior and environment in which these innovations are initiated and adopted. The following model succinctly illustrates how all the concepts fit together to form the integrated innovation process (Bernsteina and Singh, 2006).

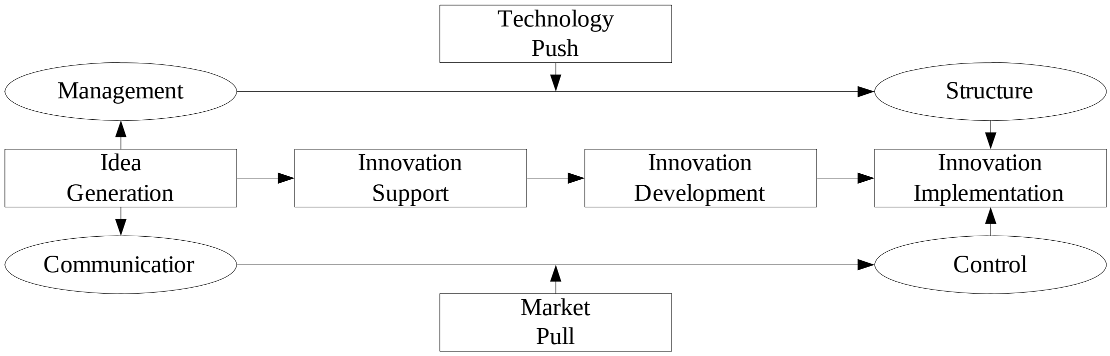

Figure 1 Integrated Innovation Process Model

3 Platform of Cooperative Education

3.1 Types of institutes

There are numerous sorts of institutions involved in training and education, research and development and the transfer of technology trying to intensify contacts between science and industry. Through policy perspective, institutions are distinguished by the following four types:

“Science” Type: The “science” type relies on considerable research funds independent of industry. It essentially finances itself by basic funding for the benefit of universities as well as funds for programs relating to fundamental or applied research.

“Practical Research” Type: “Practical research” type institutions largely cover their expenses with funds which come from R&D programs by governments and from project cooperation with industry.

“Problem Solving” Type: Industry plays a decisive role in maintaining “problem solving” type of institutions. Industry makes financial resources available e.g. via support groups or via participation in different events. However, it also supports institutes by funding research semesters for professors and provides equipment for training and education. Furthermore, it provides tasks for examinations investigations and small case studies. The institutions are thus able to manage without considerable long-term public funding.

“Rapid-Response” Type: The “rapid-response” type of institutions is mainly financed by basic funding to fulfill teaching activities. It receives no substantial funding for research or transfer purposes.

3.2 Purpose of Henan industrial technology research institute

Henan Industrial Technology Research Institute has three mission statements: first, to expedite the application of new industrial technology; second, to aid in the process of upgrading industrial technology techniques; and thirdly, to establish the communication of universities and local firms. However, in order to face a new economic era of industrial structure shifting and serving as a local technology research institute, HITRI must be the platform of cooperative education in order to support local industries.

Since inception, HITRI has been the bond of local firms, universities and government. Through those application projects, selected students can practice what they have learned in university, while employees in firms get continuous education by specialized training.

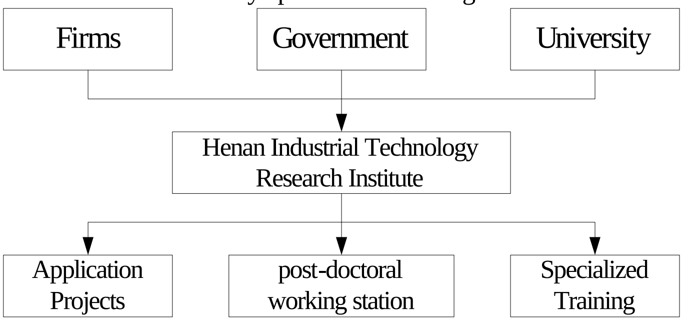

Figure 2 HITRI and It’s Functions

4 Case Study

The course of Logistics Simulation is designed to give students the opportunity to practice using the skills and knowledge from Logistics. Simulation can be an extremely powerful tool and is becoming quite widespread, yet few in industry seem well trained in the design, implementation and interpretation of a useful simulation experiment. The simulation module in figure3 is an example of production line of a package company, which is located in Zhengzhou High & New Technology Industries Development Zone. This module has two primary goals:

(1) Develop the practical skills necessary to design, implement and analyze production systems;

(2) Find the bottleneck of production system with the theory of OPT.

There are three critical machines in this production line. By the load rate indicator in figure4 of the simulation software, students can find the bottleneck machine, and provide solving plan to promote the productivity of production system.

Figure 3   Simulation Model of Production Line

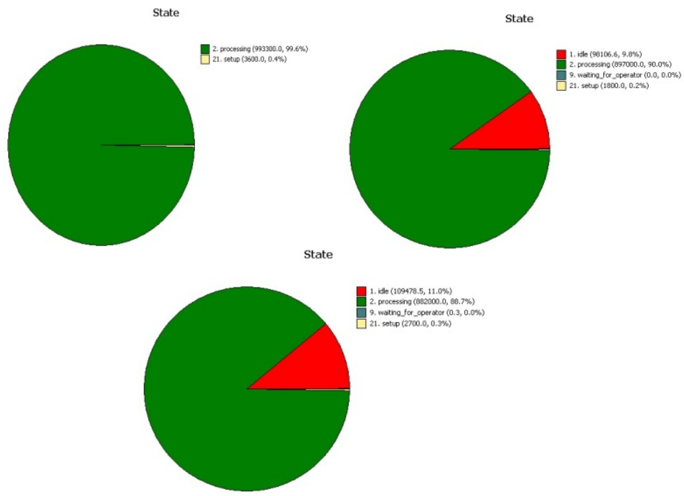

Figure 4   Load Rates of Three Production Machines

5 Conclusion

The paper started with the presumption that developers occupy one of the key positions in the development of new products. Therefore technology policy should identify developers as a key actor or important target group. It was argued that the support of the developer's professional networks should be a priority in technology policy. Public authorities implement this policy goal best by designing framework conditions in such a way that institutions become interfaces in the developers' network. Public bodies can only achieve this when they establish themselves as competent contacts as well as contributing to further development of the network of contacts. Institutions must be a turntable for the exchange between developers as well as a dynamic influence in the network. They have to support the exchange of experiences and opinions, act as a moderator and catalyst and make themselves available as the key element of interaction. Successful institutions at the interface between science and industry do not consider themselves to be an institution for transfer but a network manager. Institutions should be the supplier of developers to firms, at the same time, the place of cooperative education to universities.

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