International Journal of New Developments in Engineering and Society
ISSN 2522-3488 Vol. 6, Issue 2: 31-35, DOI: 10.25236/IJNDES.2022.060206

Research on innovative model of engineering leadership development based on action learning

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Abstract: *At present, talent competition is becoming a focus of international competition. Both developed countries and large developing countries regard scientific and technological human resources as the core factor of strategic resources and enhancing national competitiveness, and vigorously strengthen the capacity building of scientific and technological human resources. Engineering leadership training is a new direction in modern higher education. Enterprises require graduates not only to be experts in design and analysis, but also to have leadership, with excellent communication, expression, adaptation, coordination and management characteristics. In recent years, the state's investment in industrial science and technology activities has maintained rapid growth, the national financial science and technology appropriation has increased steadily, the enterprise's investment in science and technology has maintained rapid growth, and the expenditure on scientific research and experimental development has continuously refreshed historical levels. Various organizations in China are also gradually applying action learning for leadership development. From the effect of action learning and traditional methods on leadership development, this paper discusses the innovation and educational measures of leadership development based on action learning.*

Keywords: *Action learning; Engineering leadership; Leadership development; Innovation mode*

1. Introduction

In today's dynamic and rapidly changing world, it is necessary to create new skills to face increasing competition. Faced with the rapid changes in the economic and social environment, how to quickly improve the leadership of managers to effectively promote organizational change has become a major challenge faced by organizations [1]. At present, talent competition is becoming a focus of international competition. Both developed and developing countries regard scientific and technological human resources as strategic resources and the core factor to enhance national competitiveness, and vigorously strengthen the construction of scientific and technological human resources. According to the 2020 Engineer Outlook proposed by the National Academy of Sciences, it is set that engineering graduates in 2020 need to have strong analytical skills, creativity, originality, professionalism, leadership and other characteristics [2]. Leadership is a key factor in the professional development of engineers. The leadership of enterprise managers has become the core of the core. Looking for efficient and rapid leadership development methods has become one of the most concerned problems of enterprise managers.

In recent years, the state's investment in industrial science and technology activities has maintained rapid growth, the national financial science and technology appropriation has increased steadily, the enterprise's investment in science and technology has maintained rapid growth, and the expenditure on scientific research and experimental development has continuously refreshed historical levels. Various organizations in my country are gradually applying action learning for leadership development [3]. The reason why the leadership of engineers is important is that, first, engineers must be able to control and coordinate in the face of technical, economic, environmental, and ethical conflicts; second, engineers must work harmoniously in teams with different cultural backgrounds; finally, engineers' actions need to be in harmony with the public. Policy making and industry management interact. [4] In the context of today's knowledge economy, traditional learning models have been questioned due to their emphasis on static methods and their severe disengagement from action and concrete situations. For this reason, the theoretical and practical circles have affirmed and praised the action learning model emphasizing "learning by doing" and "learning by doing".

ISSN 2522-3488 Vol. 6, Issue 2: 31-35, DOI: 10.25236/IJNDES.2022.060206

2. Leadership development and innovation

2.1. Action learning and traditional methods

When using traditional methods, S Company adopted many methods to improve managers' leadership, such as course training, visiting and studying, benchmarking and case analysis. These methods have played an important role in the development of enterprise leadership and are still widely used today. However, S Company has not achieved ideal results by adopting these methods. Company b uses the action learning theory initiated by professor Revans, and puts forward the classic relationship equation of learning = program med knoledge+questioning ins ight (learning = procedural knowledge or knowledge provided by experts+insightful questioning and reflection). That is, L=P+Q. With traditional teaching and inherited knowledge as the core, P is the learning of the known; Q is characterized by asking insightful questions and is the ability to lead to the unknown [5]. From the perspective of the development process of engineering, the definition of engineering has different tendencies in different periods, which also directly affects the mode and method of engineering education. In general, action learning is a form of learning through "experience" and "doing". It is a process of continuous reflection and learning with the support of a team for the purpose of completing predetermined tasks. It is an effective learning method that combines theory and practice.

2.2. Innovative ways of leadership development

Table 1: Practical ways of leadership development

Practice	Describe	Development Goals	Human Capital	Social Capital	Advantage	Disadvantage
360 Feedback	Multi source performance evaluation organized and presented to individuals	Self-knowledge/Dehavior change	Development goals	Untargeted development goals	Comprehensive description, extensive participation	A lot of data, no guidance on how to change orders, time and effort.
Train	Practical, goal-focused one-on-one learning form	Knowledge, behavior change, career development	Development goals	Possible development goals	Individualized; centralize-d	Shame (tutoring); high cost
Tutorial system	Advising/development relationships, often with more resourceful managers	Broad understanding, generalizer of progress, lesson study/mistake avoidance	Development goals	Possible development goals	Strong personal connection	Peers are jealous and overly dependent.
Networking	Strengthen contact with people in different functions and fields	Better problem solving, learning who to ask for project help, socialization	Possible development goals	Development goals	Organization construction	Ad hoc, Unorganized
Assignment of work	Provide extended assignment based on role, function or geographic location.	Skills development, a broader understanding of business	Development goals	Possible development goals	Work-Related; Accelerated Learning	Performance and high-level voices clash; no learning-friendly structure
Action learning	Project-based learning on important business issues	Socialization and team work implementation strategy	Development goals	Development goals	Necessary business and close contact with business; Behavior orientation	Time focused; leadership lessons are not clear; too much emphasis on results

For different organizations, the specific ways and steps of implementing action learning for leadership development may be different, but in general, successful action learning must contain several key elements. Action projects usually focus on general or even research issues, rather than really challenging problems in the development of enterprises. In the practice of action learning project, domestic enterprises usually pay attention to the technical level, including brainstorming, future exploration, in-depth meeting and many other forms, while ignoring the problem solving and mental model improvement [6]. Compared with traditional learning methods, the most likely problem of action learning is that there is action but no corresponding learning, which eventually evolves into overtime working on projects. The department leaders who re-engaged in the action learning team have a process of in-depth study, practice and summarization of experience in their daily work based on the results of

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the workshop after each workshop, which ensures that the action learning project can actually be effective in daily work. As shown in Table 1, the practice of leadership development.

3. Engineering Leadership

3.1. Necessity

Nowadays, with the increasingly fierce international competition in the world, both the industrial and educational circles have put forward higher requirements for the ability and quality of future engineers, many of which are reflected in the non-technical fields, especially their leadership ability and quality.

(1) Target Questions: Issues of concern or contention are the starting point and catalyst for action learning, which may arise at the individual level, as well as at the team or organizational level.

(2) Questioning and Reflection: Questioning and reflecting are the soul of action learning, an important task for action learning teams, and one of the most difficult skills to master.

(3) Take action and learn from it: reflection without action is powerless. Only by putting it into practice can we prove whether reflection is correct and whether learning begins and achieves results.

(4) Learning team: Effective action learning is carried out in the form of a team. They should learn from the team by cooperating to solve the specific problems they face in practice. Effective action learning is carried out in the form of teams, and they have to cooperate to solve specific problems in practice.

”With the ever-increasing interdependence of technological, economic and social foundations, the opportunities for engineers to play their leadership role will greatly increase. In the context of the country's introduction of "Made in China 2025" to indicate the future direction of China's engineering education, efforts will be made to promote engineering science and technology. The development of talent leadership is very necessary and urgent [7].

3.2. Engineering leadership requirements

"Big engineering view" is opposite to the previous research-oriented engineering science view. Engineering Education under this concept emphasizes the comprehensiveness, practicality and innovation of engineering, which is neither "narrow in technology", "narrow in technology", nor "exclusive respect for science". The ability requirements of engineering talents in the 21st century under the concept of big engineering include the ability of engineering, society and self-renewal. From the perspective of grand engineering, the ability requirements of engineering talents in the 21st century are shown in Figure 1.

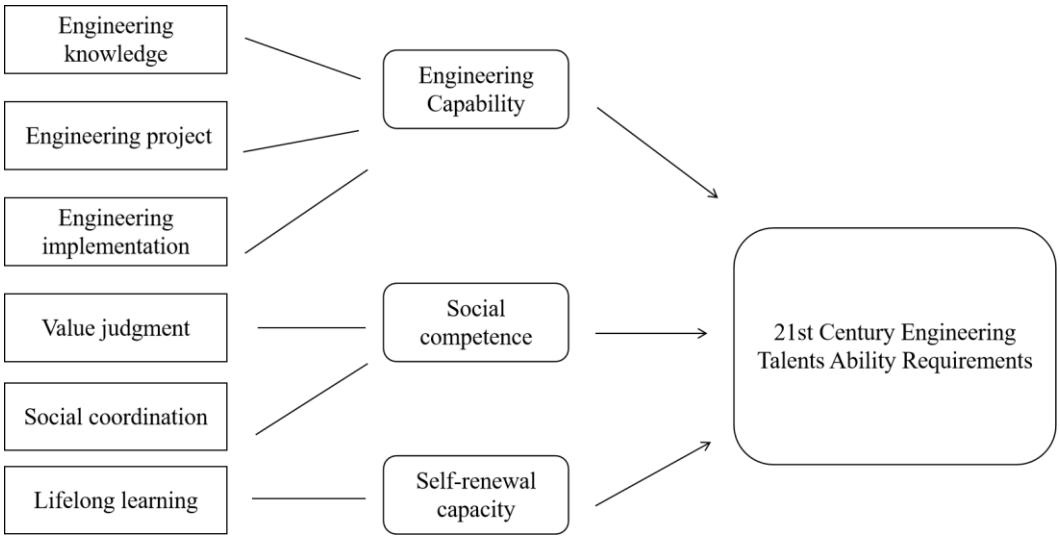

Figure 1: Requirements for engineering talents' ability

Engineering capabilities include the ability to master engineering knowledge, engineering design

ISSN 2522-3488 Vol. 6, Issue 2: 31-35, DOI: 10.25236/IJNDES.2022.060206

and engineering implementation. [8] Social competence includes value judgment ability and social coordination ability. Self-renewal ability, engineers require the ability to continuously update themselves after receiving formal education, absorb new knowledge, new methods, new concepts, and maintain their own creativity. It can be said that the social ability proposed in the ability requirements for engineering talents in the 21st century under the concept of large-scale engineering is the necessary ability for engineering talents in the process of social and economic development, especially in the increasingly complex social environment. And this just reflects the requirements for the leadership of engineering talents. Figure 2 shows the leadership requirements for engineering talents from the perspective of large projects.

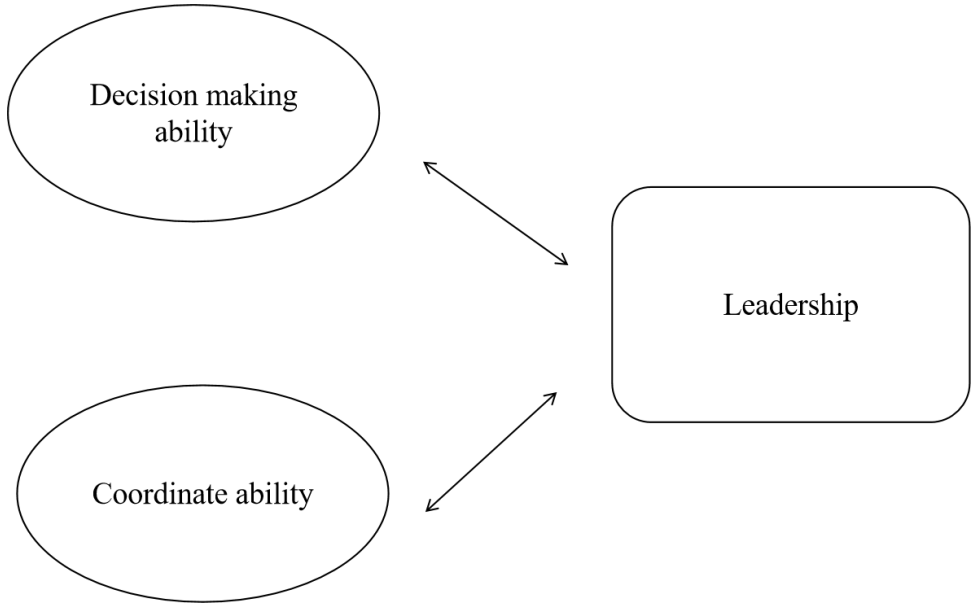

Figure 2: Leadership requirements for engineering talents under the concept of large-scale engineering

4. Measures for developing engineering leadership education in China

4.1. Strengthening engineering practice

Engineering reform should return to engineering practice, transform the technical demand of engineers into the training standard of students' knowledge, ability and quality, and add the demand into the teaching plan and curriculum construction. Especially the development of engineering talents' leadership for the future, which has distinct practical significance. For example, the Ministry of Education and the Academy of Engineering have set up an expert committee of the "Excellence Plan". The members of the committee gather experts and scholars from all aspects of production, politics, learning and research, and are responsible for guiding the organization and implementation of the "Excellence Plan" and the demonstration of the implementation plan. The "Excellence Plan" has three main features: training engineering talents. First, industry enterprises are deeply involved in the training process; second, schools are in accordance with general standards and industry standards; third, students' engineering ability and innovation ability are strengthened. "The purpose of the" Excellence Plan "is to cultivate and bring up a large number of high-quality engineering and technical talents of various types who have strong innovation ability and can meet the needs of social and economic development [9].

4.2. Strengthen cooperation with industry

Strengthen cooperation with the industry, and actively introduce and absorb human, financial, material and other resources from the industry. By inviting experts, project developers and even market specialists from education and industry to participate in vocational education activities, we can provide professional advice, consultation and evaluation for students' project design and industrial practice activities. It is also possible to select teachers to work in engineering positions in enterprises for 1-2 years through colleges and universities in a planned way to accumulate practical experience in

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engineering. Or hire engineering technicians and managers with rich engineering practice experience from enterprises as part-time teachers, Undertake the teaching task of professional courses or serve as the joint tutor of undergraduates and postgraduates, and undertake the tasks of training students and guiding graduation design [10]. So as to achieve the purpose of enhancing students' satisfaction with their careers and loyalty to enterprises, and finally improve the productivity and quality of enterprises.

5. Conclusions

To sum up, an excellent engineer needs to have cognitive ability, innovation, organization and management team ability, and assume more responsibilities. An excellent engineering leader should have both business leadership and engineering leadership. Its competitive elements are mainly classified into three categories: Basic knowledge, emphasizing scientific and technological knowledge and logical reasoning based on the subject foundation; Engineering ability, skills to explain and identify problems, engineering ability in cross-culture, environment and globalization; Professional leadership traits, including effective communication, personal welfare considerations, intellectual inspiration and the ability to work in interdisciplinary and cross-cultural teams. With the increasing global competition, the development of engineering leadership should be based on perfect engineering education. With the continuous development of economy, society and science and technology, engineering leadership will become more and more important. Because: the future engineers more and more need to control and coordinate the contradictions and conflicts between non-technical factors such as economy, environment, ethics and technical factors, and are good at working harmoniously in cross-cultural and inter-professional teams. The development of engineering leadership is a long-term process that requires continuous improvement based on social and technological changes. Educators must examine educational policies and models from the immediate and long-term needs of the market to develop the leadership engineers that the industry expects.

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