Research on Organization Management Optimization Driven by Intelligent Technology

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Abstract. With the continuous upgrading of intelligent technology, which technology organizations and managers choose to enhance their management ability is an urgent problem to be solved. The goal of this paper is to find the best matching scheme between management functions and various technologies so as to improve the efficiency of managers engaged in engineering management and project management. First of all, the relationship between the extent of management and management efficiency is discussed. Secondly, represented by cloud storage, holographic projection, artificial intelligence and Internet of Things, management functions are divided into memory, communication, decision-making and monitoring functions, and each function is divided into three dimensions. Then, through questionnaire survey, Likert Scale was used to score these dimensions of technology and function, and the spatial coordinates of management sub-function and technology points were obtained based on the score. Thirdly, the filtering algorithm is used to calculate the spatial distance between two points to determine the matching degree of technology and function. The conclusions of this paper are as follows: cloud storage technology assists memory, holographic projection assists communication, artificial intelligence assists decision-making, and Internet of Things assists monitoring.

Keywords: technology-driven · organizational structure · flattening · technical matching

1 Introduction

The drawbacks of hierarchical organization are prominent [6]. Hierarchical organization is accompanied by industrial society, which greatly improves the productivity of human society. However, it is difficult to adapt to the current intelligent network era characterized by artificial intelligence and the fusion of virtual and reality, due to its drawbacks such as distorted information communication, high cost and restrained employee innovation [5]. How to improve the efficiency of managers to promote the flattening of organization like an engineering department will be an urgent problem for organizations to solve.

The use of technical means to assist managers to broaden their management scope, and make the internal information communication within the organization smooth,

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reduce the management cost, stimulate the innovation vitality of employees [7]. However, there are many obstacles in the process of organizational structure flattening. The classical "management scope" theory holds that management scope is limited by the energy, and brain functions of managers [2]. The main obstacle is the limitation of managers' brain functions, including memory, communication, decision-making and monitoring. Technology, as an important element in the expansion of management scope, can achieve technical empowerment through the effect of brain ability, so the brain ability can be directly equivalent to the management ability of managers [9]. However, there are few researches on how technology can assist managers to establish "external brain" to broaden their management scope. Therefore, by refining the obstacles to broadening the management scope, this paper finds out the combination of technology enabling management scope expansion, and analyses the breakthrough direction of management scope from the perspective of brain ability to promote the flattening of organizational structure.

Engineering project management is becoming complex, on the one hand because of the expansion of project scale, on the other hand because of the large amount of information involved in project management. This requires managers to have enough ability. The use of technology to empower managers to improve their management efficiency will become standard in organizations [4]. In order to cope with the challenge brought by the coming technology, it is urgent for organizations to explore the enabling path of intelligent technology in the organizational management.

2 A Conceptual System of Flat Organizational Structures

2.1 Core Concept Definition

Management scope: The number of subordinates that managers can directly manage in an organization.

Management level: The number of levels of management positions in an organization from the top executive to the bottom line.

Management efficiency: Assume that subordinates under the direct management of the manager play a role to a degree, the scope of management is b. Management efficiency not only seeks to maximize the role of direct management of subordinates, but also requires to manage as many subordinates as possible, which reflects the scope of management ability of managers, that is numerical embody the maximum value is the product of a and b.

Flattening: A process of organizational streamlining by increasing the scope of management for managers and reducing the number of levels of management in an organization.

2.2 The Theoretical Basic of the Flattening of Organizational Structure

2.2.1 Optimal Management Scope Theory

The relationship between management scope and management efficiency presents an inverted U-shaped function. When the manager has a certain capacity, the management

efficiency of the manager first increases with the increase of the management scope. When the management scope exceeds the optimal management scope, the management resources allocated by the subordinates per capita gradually decreases, and the management efficiency decreases with the increase of the management scope.

2.2.2 Theory of Intelligent Technology to Improve Management Efficiency

Management is to command subordinates' mental work, and the upper limit of managers' brain capacity determines the number of subordinates they can directly manage. For managers, the way to expand the scope of management is to establish the outer brain by using technology to improve its brain capacity, and then improve management efficiency. When the management plays the same role, with the continuous upgrading of the technical level, the management efficiency of the manager is improved, and the management scope is broadened accordingly.

However, the upgrade of technology cannot expand the scope of management without limit, so the growth rate of efficiency will gradually slow down and maintain a slow growth rate in the later stage.

2.2.3 Technology-Driven Framework

The obstacles to broadening the scope of management stem from the biological limitations of the human brain. The brain cannot store an infinite amount of information. The brain has limited computing power, data processing power, etc. The brain needs to rest after working continuously for a period of time. These elements act on the core functions of the brain and restrict the broadening of the scope of management. The core functions of the brain mainly include memory, language, execution and attention, which are respectively reflected in the management scene: memory, communication, decision-making and monitoring.

Technologies such as artificial intelligence and the Internet of things can enhance the core functions of managers' brains [1]. The intelligent technologies mentioned in this paper are represented by cloud storage, holographic projection, AI and Internet of Things [8]. All of these smart technologies empower the core functions of the brain. The enabling process is shown in Fig. 1.

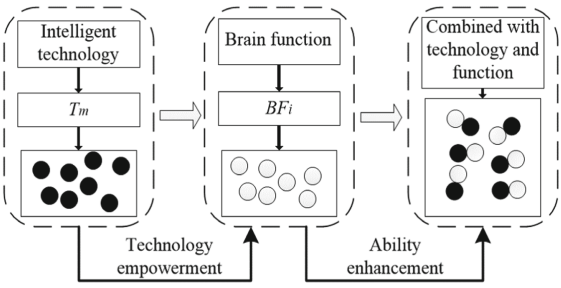

Fig. 1. Technology-driven framework.

3 The Flattening Model of Organizational Structure

3.1 Technical Drivers of Management Efficiency

Step 1: Find the extreme value of the curve of management scope and efficiency. Since the curve is an inverted U-shaped continuous differentiable curve, the x-coordinate of the maximum point is x_0 and the y-coordinate $f_0(x_0)$ can be obtained by differentiating the curve. At this time, the optimal management scope and efficiency point of the current technical level can be obtained, as shown in Fig. 2.

Step 2: Cite technical parameter t. Technological upgrading makes the optimal management scope and efficiency point shift. The details are shown in Fig. 3. Among them, the management scope and efficiency curve at t_0 technical level is represented by $f_0(x_0)$ and at t_1 technical level is represented by $f_1(x_1)$.

By comparing the two curves, it can be found that technological upgrading broadens the optimal management scope and improves the corresponding management efficiency.

3.2 Measure of Management Capability

Brain functions can be divided into memory, communication, decision-making and monitoring, and these sub-functions are subject to several elements. Each element has its corresponding weight, and the higher the weight, the higher the influence of the element

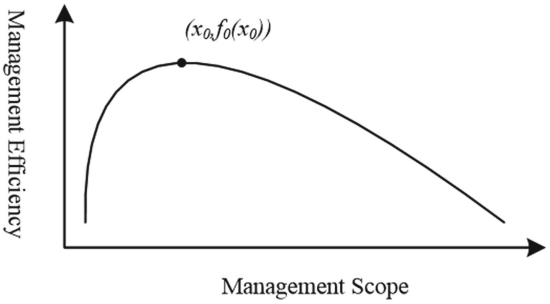

Fig. 2. The curve of management scope and efficiency.

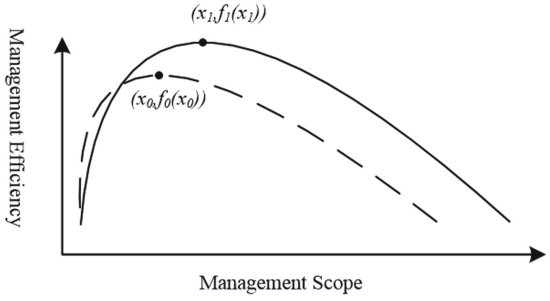

Fig. 3. Management scope and efficiency curves under different technologies.

Table 1. Management ability measurement system.

Management ability measurement system		
management sub-functions	***functional elements***	***weights***
Memory function (BF_1)	Employee information (z_{11}) Task assignment (z_{12}) Task execution (z_{13})	w_{11} w_{12} w_{13}
Communication function (BF_2)	Video conference (z_{21}) Departmental discussion (z_{22}) Customer communication (z_{23})	w_{21} w_{22} w_{23}
Decision function (BF_3)	Information processing (z_{31}) Assist decision making (z_{32}) Outlook forecast (z_{33})	w_{31} w_{32} w_{33}
Monitoring function (BF_4)	Post attendance (z_{41}) Work process (z_{42}) Business performance (z_{43})	w_{41} w_{42} w_{43}

on a sub-function of management. Therefore, management sub-functions, functional elements and weights constitute the management capability measurement system, as shown in Table 1.

3.3 Element Weight and Intensity Determination

3.3.1 Method of Element Weight Calculation

Through interviews with some managers, score of each element layer is obtained, and w_{ij} ($i = 1,2,3,4$, $j = 1,2,3$) of the weight of each element relative to the function is calculated, indicating the weight of the JTH element of the ITH subfunction under the subfunction, and the sum of the weights is set to be 1.

3.3.2 Method for Calculating the Intensity of Subfunctions

Managers score the importance degree of each element in the ITH subfunction of management function by Likert Scale, and get the score x_{ij} of the JTH element in the ITH subfunction of management function $i = 1,2,3,4$, $j = 1,2,3$, and $x_{ij} \in (0,1)$).

3.3.3 Measurement of Subfunction Vectors

The element intensity of each management sub-function can be calculated as:

$$z_{ij} = w_{ij} \cdot x_{ij}. \tag{1}$$

Then, according to the intensity of each element under each function, the sub-function intensity represented by three-dimensional vector is obtained, as in

$$BF_i = (z_{i1}, z_{i2}, z_{i3}). \tag{2}$$

4 Technology-Driven Filtering Algorithms

On the premise that each sub-function in management function is represented by three-dimensional vector, the concept of three-dimensional space is introduced. However, since management function and technology are two different types of variables, the three-dimensional space is extended to a parallel space model.

Firstly, build the management element space as shown in Fig. 4. Axes Z1, Z2 and Z3 represent the intensity of the first element, the second element and the third element respectively. Think of the intensity of management sub-functions as points in a three-dimensional space (z_{i1}, z_{i2}, z_{i3}).

Next, build the technology space as shown in Fig. 5. Consider cloud storage, holographic projection, artificial intelligence, and IOT as a combination of two elements. The technology space is a two-dimensional plane, and the axes are set as α and β respectively. These four technical points T_m, whose coordinates (t_{m1}, t_{m2}) represent the element intensity values of each technology on the α and β axes.

The matching degree between management function and technology is defined by the distance between BF and T, and the distance is inversely proportional to the matching

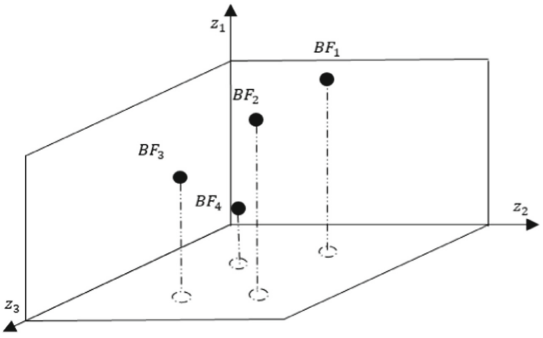

Fig. 4. Management element space.

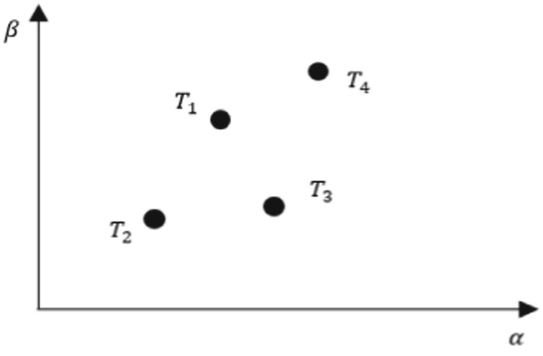

Fig. 5. Space for technology

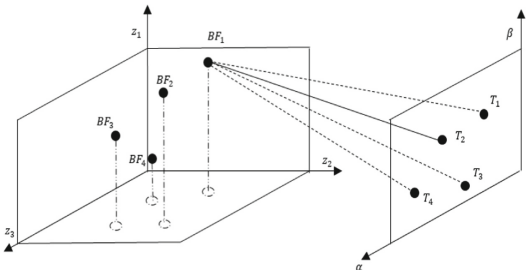

Fig. 6. Spatial distance correlation

degree. The closer the distance is, the more matching the technology represented by this point is with the corresponding management sub-function.

The technology space is regarded as a special three-dimensional space whose one-dimensional coordinates are always 0, and its coordinate points can be extended to (t_{m1}, t_{m2}, *0*), then the distance between the ITH function BF_i and the MTH technology point Tm can be expressed as:

$$L_{BF_i T_m} = \sqrt{\sum_{k=1}^{3} (z_{ik} - t_{mk})^2} \tag{3}$$

In Fig. 6, taking the memorization function as an example, L is the largest, indicating that the memorization function has the highest matching degree with the cloud storage.

5 Implementation Path

The implementation path refers to the combination of technology and management sub-functions, and the use of technology to empower managers and improve management efficiency.

5.1 Cloud Storage Provides the Memory Function

With cloud storage, office devices do not need large-capacity local hard disks, and organization members can operate files anytime and anywhere. In addition, the delivery, assignment, and execution of all tasks can be stored in the cloud database. The manager can freely view the task execution and track the task progress in real time. All employee information can be uploaded to the cloud database and sorted out. Managers only need to retrieve employee information by corresponding code. Through 5G terminals, office cloud collaboration can be realized. Members of an organization can operate unified files on different terminals, which can effectively reduce the delay and limit the file size, and improve the collaborative office capability.

5.2 Holographic Projection Enables Communication

Offline meeting communication requires managers to be close to their subordinates, and they need to determine the time and place of the meeting in advance, and then inform

relevant personnel to attend the meeting. In the preparation stage of the meeting, a lot of time is needed, and the quality and effect of the information transmission of the meeting is far inferior to that of offline physical meetings. Holographic projection based on 5G can realize group simulation of meeting scenes among members by recording and reproducing light wave information, and connect meeting data in real time. The application of holographic projection enables high frequency and efficient communication among members in the organization network constructed by information, accelerates the speed and accuracy of information transmission, and effectively inhibits the drawbacks of information transmission distortion and "bullwhip effect".

5.3 AI Enables Decision Making

With the continuous development of AI and deep learning algorithm technology, managers' decision-making has changed from "relatively rational" to "absolutely rational". The reason is due to the auxiliary and substitute role of AI.

Firstly, AI can simulate the logical thinking process of human beings in dealing with problems, and generate a variety of alternative solutions based on historical records to assist managers to make more scientific and reasonable organizational decisions. Secondly, the AI robot can also simulate human behaviours, realize the personification of the robot, so that the robot has the ability of independent decision-making and analysis, based on the existing information data premise, predictive decision-making [3]. Assisted by AI, managers break through the brain limit and become rational decision-makers.

5.4 Internet of Things Enables Monitoring

The monitoring function is mainly used to monitor employees' task behaviours and work scenarios in enterprise management. Thanks to the control of massive data in these two aspects, managers can better manage enterprise business performance, human resources, human-post matching and so on.

After the enterprise office equipment is connected to the Internet of things, it will generate massive perception data of interaction and interconnection between employees and work scenes, which can digitize employees and work scenes. Managers analyse the matching relationship between positions and abilities based on the data generated by the Internet of things to reduce human resource waste and internal management costs.

6 Engineering Case

As a revolutionary management technology, building information model technology has gradually become a very important means of engineering project management. It provides engineering project managers with the ability to obtain information and make decisions.

The construction project of Guanglianda Information Building uses BIM technology from scheme decision-making and design to engineering construction.

In terms of construction, the project analyses the model through BIM technology and makes feasible management decisions. Improve the efficiency of managers' decision-making stage.

In terms of progress management, the project manager uses quarterly cards to prepare engineering plans, which is convenient for managers to manage the construction progress of the site.

In terms of safety management, managers use BIM model to expose the hazard sources in the process of engineering construction and carry out a purposeful pre-control of the project. At the same time, we can see the situation on the ground and carry out all-round video surveillance.

Therefore, the application of intelligent technology can improve the efficiency of managers.

7 Conclusions

Based on cloud storage, holographic projection, AI and IOT, this study explains the basic logic of different functions of managers' brain assisted by technology, and discusses the screening algorithm and enabling path of technology matching brain function. The main conclusions are as follows:

Firstly, there is an inverted U-shaped relationship between management scope and management efficiency.

Secondly, technology can empower managers. For managers, they cannot have enough management ability, and their management scope can only be expanded within a certain scope. With the assistance of technology, the brain function of managers can break through the constraints of biology, and the management scope can be greatly improved.

Thirdly, technology has multiple enabling paths for management functions. The best enabling path is cloud storage enabling memory, holographic projection enabling communication, AI enabling decision-making and IOT enabling monitoring.

The limitations of this paper lie in the lack of specific case evidence and the subjective impact of Likert scale scoring on the results. Next, we will expand the scope of the survey and discuss the enabling mechanism of multiple technologies for a single function.

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