

The Exploratory Research on Reform and Innovation of Project Management in Grid Enterprises under the Changing Circumstances

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Abstract. At present, the management systems and enterprises demand have already changed because of the environments-changing, which puts new requirements and directions for grid enterprises. This research comprehensively analyzes the current situation and problems of the project management, and then explores the profound impact of the new situation to the project management system in power grid enterprises. After that, this research also summarizes the reforms and innovation experiences of the power grid enterprises in the project management, and extracts the project management characteristics of the grid enterprises under the new situation. At the same time, based on the project management practices, we provide a new method and implementation path for grid enterprises. This method and path provide theoretical and methodological support for relevant grid enterprises to improve their management efficiency and improve organizational performance.

1. Introduction

With the opportunities brought by overseas power projects under China's "One Belt And One Road" strategy and the strategic implementation of energy "Four revolutions and one cooperation", the power industry needs to deepen the system reform, boost energy conservation and emission reduction, and meet the needs of clean energy development, so as to play the leading role of energy technology innovation and promote the efficient and clean, green and low-carbon development of the power industry. However, due to the acceleration of economic globalization and the emergence of emerging technologies, the governance of the power industry in the organizational reform faces the challenges of organizational structure, implementation environment and technology complexity [1]. Under the background of the new era, in order to ensure that the organizational change of the power industry is consistent with the internal and external appropriateness change of the organization, enterprises need to promote and reduce the risk of implementing controversial changes through "value work" in the process of organizational change, and coordinate the conflict between change and sustainable stability (Raynard etc, 2020)[2]. As the driving force of leaping development, project management has become a golden key to the door in the transformation of the power industry and an important part of "value work", determining the ability and potential of power enterprises to deal with market changes. As an important means to implement corporate strategy, improve lean management level and enhance resource allocation ability, project management of power grid enterprises is of great significance to build a value system of project management for improving project collaborative management



efficiency, innovating new project management mode and new technology, and realizing lean management and sound investment of projects.

In recent years, the state has introduced a series of policies to promote the development of "Internet Plus" smart energy, requiring enterprises to optimize the business environment and improve the regulatory efficiency. The State Grid followed the national energy development strategy to establish the development goal of building an "International leading energy Internet enterprise with Chinese characteristics". Under the new situation, the project focus of power grid enterprises' investment has changed, and the new requirements on the management and operation behavior of power grid enterprises, especially the project management, also show the importance and urgency. Power grid project management needs to be innovative and intelligent development under the situation of energy Internet. At the same time, power grid enterprises also need to improve cost management and supervision, etc. The scientific and efficient selection of control mode has become the core problem of power grid enterprises.

Some studies have pointed out that under the background of the era of big data, power enterprises should change their thinking mode, lead innovation with data, optimize the enterprise structure with data, and then drive the upgrading and development of project management (Han Gang and Li Wenrui, 2021)^[3]. Big Data can provide decision-making information for project management and make it scientific^[4]. At the same time, due to the characteristics of organizational diversity and complexity, in order to improve the performance of project management, we need to build a project management mode, including decision-making, control, and communication, and comprehensively considering stakeholders, environmental and organizational management models^[5]. Such as Alhazmi (2000) Project Construction Management Evaluation System, Wong (2004) Project management mode selection model and (2020) power grid side energy storage project management mode selection model like Nankai Hui^[6-8]. Due to the rapid technology development, changing energy development mode and operating environment, power grid enterprise projects differ greatly from other types and different requirements for project construction management mode. The studied project management mode cannot meet the new form and characteristics of the energy development strategy of power grid enterprises.

Based on this, this study introduces data cognitive horizon technology, from the point of view of project stakeholders, builds project management value system covering enterprise value, customer value, supplier value, subcontractor value and social value, and carries out data-driven grid enterprise project intelligent control technology and application research, effectively improve the efficiency of the company project collaborative management, promote the development of new forms, new models and new technologies, promote the transformation and development of grid enterprises, realize the value of state-owned assets and enterprise value.

2. Analysis of the Project Management Status of Power Grid Enterprises

2.1. Project management of the power grid enterprises

The project management of power grid enterprises is the process of taking the project construction progress management as the main line, promoting the project construction according to law and compliance in an orderly manner, and comprehensively realizing the project construction goals through planning, organization, control and coordination. The main management contents include schedule management, construction coordination, selection of participating team involved, contract performance management, information and file management, summary evaluation, etc. The requirements of safety, quality, technology and cost management are clear in their respective professional management regulations.

2.2. Project management status of power grid enterprises

At present, electric power enterprises are in the strategic opportunity period of accelerating development. In terms of external environment, the reform of electric power system, the significant

improvement of power consumption level, the continuous expansion of power grid scale, the continuous improvement of customer demand, and the new round of rapid development led by Internet technology require power grid enterprises to make full use of blockchain, data mining and other new technologies to improve the level of project management and decision-making; In terms of internal environment of power grid enterprises, power grid enterprises have advantages such as strong business ability, strong financial strength and good brand reputation, but at the same time, they also have disadvantages such as imperfect information platform construction and low operation and management efficiency.

At present, the project management mode of power grid enterprises is mainly the comprehensive plan management mode and the special plan management mode. The research on comprehensive plan management by the Chinese power grid enterprises mainly focuses on the comprehensive plan based on information system, target balance optimization, and research on comprehensive plan index system. The special plan management mainly includes 16 types of special projects, such as power grid infrastructure, power grid information construction, research and development, and equity investment, emphasizing the completion of plan formulation, management and performance evaluation within each functional department, and clear plan responsibilities, which is conducive to the enterprise management to assess the work performance of each functional department. In addition, power grid enterprises based on the characteristics of the power industry, implement a series of project management mode characteristic application, such as the "2+1+2" structure of Zhejiang Company with two analysis, one evaluation and two evaluation, accurate project reserve management of Shanxi Company, direction planning, strong control and reevaluation of Sichuan Company, classification and classification of investment projects of China Southern Power Grid Co. Ltd.

2.3. Main problems and difficulties in the Project Management of Power Grid Enterprises

With the development of modern power grid enterprises, the objective environment is becoming more complex, and the accuracy of project management and its corresponding implementation degree are demanding more stringent. Although the comprehensive plan management and special plan management have been used in power grid enterprises for a period of time and have achieved obvious results, there are still some problems judging from the actual implementation of the project management of power grid enterprises:

2.3.1. Lacks flexibility in planning

In the preparation of power grid planning, it need approval and recognition at all levels, complex process, rigid, poor flexibility, and lack of overall analysis and management of project time. Local power supply enterprises do not take the initiative to adapt to market competition, unable to the requirements of rapid planning and rapid implementation; all functional departments lack refined specialized plans and measures when formulating professional plans.

2.3.2. Lack of interaction in coordination and management

In the external environment, the government continues to carry out the reform of the administrative examination and approval system, such as "interactive" transformation, "government and enterprise cooperation, delegating power and service", which put forward new requirements on the existing model of power grid enterprises. Secondly, the construction of the substation site and line route of the power grid project involves many aspects, and the intersection with the urban pipe network, road network and track has increased, and it is more difficult to coordinate with all parties in the society. In the internal environment, there are barriers in the management of the functional departments of power grid enterprises. In the implementation process, the connection between the comprehensive plan index and the special planning index of the departments cannot be systematically unified, leading to the overall implementation efficiency is not high, which is comprehensively reflected in the project not closed by the ERP system.

2.3.3. Lack of guarantee for information collection

The comprehensive plan management of power grid enterprises involves many majors and departments. In the statistics and relevant data, there is a lack of unified data caliber and clear division of professional data statistics, and there are problems such as information collection error and data statistical data cannot be timely shared. In the special plan, there are difficulties in taking multiple systems and cross-departments and large workload, leading to the unification and use of system data. In addition, there is no way to verify the information accuracy of the information collection, and the information source is not guaranteed.

2.3.4. process supervision not inadequate

At present, China's power grid investment, operation supervision and price supervision are different departments, and it has not formed a closed loop. In the comprehensive plan, the enterprise controls the other progress of the execution stage of the project and is out of control, there is no warning for the important nodes of the project, and the development ministry is unable to take effective measures after the expiration. The special plan cannot intuitively grasp the overall and classification of the investment plan, and the investment implementation and remaining situation lead to the inadequate tracking and analysis of the progress information in the implementation process of the project investment, and the inability to implement the unified management of the investment of the power grid project.

3. New Situation and New Requirements for the Project Management of Power Grid Enterprises

3.1. The New Requirements for Deepening the Reform of the Electric Power System

At present, the power system reform of our country into the deep water area. The profit pattern of power system reform changed the power grid enterprises, the biggest impact on power grid enterprises, and it will power grid enterprises by the original power trading into power flow, make the power grid enterprise lost control of electric power marketing, let to sell electricity grid enterprises as the main source of income to net charge, power grid enterprise profit model fundamental change will occur. With the deepening of power system reform, power users can directly trade power with power generation enterprises, and the pilot project of increasing volume distribution network is gradually liberalized. Since the distribution grid business is mostly piloted in relatively developed areas, and it needs to be renovated and expanded on the basis of the existing power grid, the existing power grid architecture and power supply quality put higher requirements for the existing project management model. In addition, in order to promote the implementation of the strategic thought of "Four revolutions and one cooperation", give full play to the leading role of energy technology innovation, and promote the efficient and clean and green and low-carbon development of the power industry, it is urgent to strengthen the management of power demonstration projects under the new situation of the development of the power industry.

3.2. New requirements for the environmental change in the power grid industry

With the goal of "carbon peak, carbon neutral", accelerate the construction of diversified clean energy supply system of power grid enterprises, accelerate the change of power generation structure, rapidly emerging efficient intelligent energy consumption mode represented by data center, 5G, support new infrastructure of customized, intelligent and high standardized mode of energy consumption demand is also increasing. Under the new pattern of energy demand change development, power grid enterprises as connecting power production and consumption, promote industry and social carbon reduction hub platform, need to speed up the construction of strong smart grid, promote the traditional power grid upgrade to the energy Internet, promote clean energy supply, electrification of energy consumption, energy utilization efficiency, energy system marketization. The construction and upgrading of power grid and the construction of multiple clean energy supply system need to strengthen the power grid project management ability. By improving the scientific and effectiveness of project management, the power list system and the responsibility list system of energy investment project management should

be established, and the accountability mechanism should be improved. Through project management, a management mode with policy-based conditions guidance, enterprise credit commitment and effective supervision constraints as the core should be established.

3.3. New Requirements for Strategic Target Adjustment and Mechanism Transformation of Power Grid Enterprises

Under the development environment with distinctive advantages with Chinese characteristics and the intelligent digital level of the power grid being significantly improved, and according to the characteristics of "double high" and "double peaks" of the power system are constantly highlighted, the State Grid has put forward the development strategy of building an internationally leading energy Internet enterprise with Chinese characteristics in an all-round way. The strategy requires power grid enterprises to grasp the hierarchical connection, realize planning, planning, budget, assessment through the project management, realize the strategic objectives of the complete project management mode, promote the project and strategic docking, strengthen the project operation analysis and tracking evaluation, and then improve the company's strategic management level.

3.4. New requirements for the popularization of the new-generation information technology

At present, the global information technology innovation is accelerating, with big data, cloud computing, the Internet of Things, artificial intelligence, blockchain represented by a new generation of information technology booming, the power industry to blockchain, artificial intelligence and other cutting-edge technology support infrastructure special upgrade speed is accelerating, the combination of intelligence and automation is more and more close. Digital technology has an increasingly significant role in accelerating the upgrading of power grid to energy Internet. Digital transformation is not only the application of new technology, but also drives the reconstruction and management mode reform of power grid enterprises through new technology. With more scientific, economic, efficient and green project management mode, build enterprise project management system with marketization, transparent and efficient efficiency, scientific and efficient allocation of human and property core resources, improve enterprise lean management and decision support ability, realize high-quality development, realize digital transformation of power grid production, enterprise operation and customer service^[9].

4. Project Management Change and Innovation under the New Situation

4.1. Project management changes under the new situation

At present, power grid enterprises are in a period of strategic opportunities to accelerate their development, and the external environment makes profound changes. Power grid enterprises are required to more carefully analyze the situation, grasp the new requirements, seize the new opportunities, and make changes to the existing management mode. Based on the internal and external situation of enterprise transformation, the project management system of power grid enterprises should achieve the goal of informatization, standardization, intensification, and flattening, so as to ensure that the power grid enterprises can achieve lean management, maximize the value, and successfully respond to the new situation of power grid transformation and development and power system reform.

4.2. Organizational structure of innovative project management

The construction of project management organization structure can effectively improve the project management ability, help enterprises identify the "pain points" in development, then establish a mechanism for normal change management, and realize the implementation of enterprise strategy. Studies have indicated that project-oriented and matrix organizational structures are more effective for successful project implementation^[10]. In order to ensure the flexibility of project management organization and meet the needs of enterprise project management, the enterprise innovates the project management organization structure, builds matrix-based PMO management organization structure, as

shown in the figure, the organizational structure of project management based on PMO is strategy-oriented and clearly defined with rights and responsibilities. By constructing a learning organizational structure, organizational flexibility is realized and dynamic management of projects is carried out to improve the adaptability of enterprises.

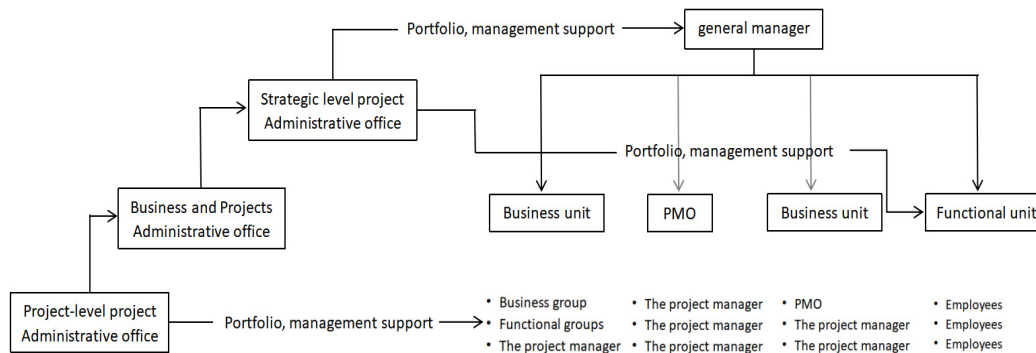


Figure 1. Functional Level Setting of the Project Management Office

4.3. Innovative management form of project management

Facing the complex situation and the development of heavy duty, shift company program mode, actively promote the application of new technologies, such as big data in the grid, to solidify the business process, refined, work standards, optimize the allocation of resources play a more active role, therefore power grid enterprise project management of new form should include data management, agile management, fingers and other advanced project management method.

Data management is the process of effective collection, storage, processing, and application of data using computer hardware and software technology. The purpose is to maximize the role of data. The main characteristics of agile management are reflected in the management responsibilities. Through iterative incremental development, it continuously delivers available products to customers, and actively responds to customer demand changes in real time. Under the agile development approach, it emphasizes the human factors, not the process. Fingertip management Using Internet technology, through the control on your fingertips, you can realize the real-time management and control of key projects, real-time sharing of key project approval ledger, real-time scheduling of communication and coordination issues, etc., so as to improve work efficiency and accuracy. Through the above management concept, power grid enterprise project management information, standardization, intensification, flattening.

4.4. Innovative Management Technology of Project Management

Combined with the digital economy development situation, based on BIM, big data, advanced technology, such as artificial intelligence, digital built into a new type of management technology, project management through digital upgrade, with "invisible" data automation to drive the "visible" project management of intelligent, digital construction will not embedded terminal system, intelligent control system such as an intelligent network formation, makes the grid as well as between products and the construction site, engineering equipment, makes the working parts, through the virtual and reality of interconnection, the construction site, the production equipment, equipment, and construction of the Internet connectivity and realize the interconnection between the digital world and the physical world, the digital information system and human to maintain exchanges, realizes the "construction site" and "project management" free communication. All processes and production factors are monitored in real time and analyzed by data mining in real time to realize intelligent management and supervision of project quality, safety, progress and green construction.

In addition, the development of Internet information technology promotes the close coupling between the real world and the network world, and the data cognitive horizon provides an optimization

path for the project management system. The Data cognitive horizon is the "human-machine-to-object" ternary coupling system of the "Physical + Network + Social" (cyber-physical-social systems, CPSS). The basic physical attribute information between objects is incorporated into the Internet in the form of data translation, and the correlation between objects based on the information platform is established. At the same time, the correlation between objects is associated with specific object concepts or sensory words and sentences, establish the corresponding cognitive and perceptual modes, form human consciousness and cognitive modes, and realize the "human-machine-object" ternary coupling system. Through the data cognitive horizon, high precision, high quality, large scale, high frequency repeated confirmation, short time and speed can be realized, improve the ability of cognitive understanding, better grasp and control the objective things, and then realize the optimization of the project management system.

4.5. Innovative project management mode

In the background of the digital transformation era, the previous project management mode has been difficult to control the complex system of nonlinear relations with multiple factors. As shown in the table, under the new situation, various industries take project management as the starting point, and realize the transformation from functional to matrix and process-oriented organization. At the same time, some new management models continue to emerge, such as life cycle management mode, digital project management, reform project management, intensive management mode, etc., to improve the enterprise project management ability. At present, in the process of agile digital transformation, the innovation of project management mode has become an inevitable choice for enterprises to cope with internal and external environmental changes, and also a realistic need to achieve high-quality sustainable development.

Chart 1 The Model of Project Management

Types	model of project management	meaning
Traditional management model	Job	The power of the project manager, the availability of resources and the configuration of the budget increase in order
	matrix	
	project	
New management model	Enterprise project cost full life cycle management model	Focus on the complete life cycle of the project, and guarantee the total return on investment under the preset market premise, so as to lead the total cost
	Digital project management	Modern information technology and advanced management concept of integration
	Transformative project management	Reform +project management
	Intensive management	Concentrate production factors and carry out unified configuration

5. Innovative Strategy and Implementation Route of Project Management of Power Grid Enterprises under the New Situation

5.1. Innovative Strategy of Project Management of Power Grid Enterprises under the New Situation

Under the new situation, the innovation of project management of power grid is from the global perspective. In order to adapt to the new form and new characteristics of power grid enterprise development, the innovation of project management needs to meet the direction and requirements of the strategic development of power grid enterprises, and needs to further improve the efficiency and

profit of project management. Therefore, the optimization and innovation of the management system need to comply with the three principles of centralization, standardization and informatization.

Concentration is manifested as a physical layer of centralization, Centralized of IT system, By the centralized construction concentration of each professional support system, Achieve the effective control of the project construction information, Centralized management of the construction quality progress, Achieve the improvement of the construction efficiency; Centralized of Logic layer, The centralization of business rules and processes, For enterprise management, In the project construction field, Including financial management, bidding and procurement, process quality and progress control, By the implementation of the management system, working flow, and professional specifications, Achieve the centralized management of the whole process of project construction, Improve management efficiency and profit.

For the project management of power grid enterprises, the standardization is mainly reflected in the operation and management standardization of organization, process and system. The standardization of the organization achieve the coordination, dynamic and convenient adjustment between organization, post and business, to form a relatively stable post work standard, to establish the connection relationship between post, authority, role and process, and to eliminate the impact of organization and post changes on the process, and to effectively support the organizational reform of the company. The standardization of process system is to build a complete engineering construction management process structure of the enterprise combined with the work of power grid projects. By sorting out positions, roles, tools and other forms, to ensure that each process element can be dynamically referenced and dynamically modified, so that the business process can be described, operable, analyzed and measurable. The standardization of the system emphasizes the design of standardized system architecture, the establishment of scientific system management mechanism and information support.

The idea of realizing informatization in the field of power grid projects firstly centers on power grid projects, integrating network capability, resource management, investment management into one, establish clear responsibility system, reasonably divide approval authority and execution authority, ensure the specification and rapid response of business process and system; finally, adopt fine assessment to achieve full monitoring and closed-loop management of resource allocation.

In order to optimize the project management of power grid enterprises, it presents a new form of data management, agile management and fingertip management, and forms a new feature of informatization, standardization, intensification and flattening. Based on the data cognition horizon, Selected the project management optimization and innovative ideas of power grid enterprises, scilicet construct the core element of constructing the value system of project management "IOPC". Interest, achieve the objective management of project management, meets or exceeds relevant requirements and expectations of the project; Organizing, emphasizes integration, coordination and overall characteristics of management; Pertinence, emphasizes the need to focus on different key elements and complete using different methods; Creativity, focuses on dynamic project management and realizes effective management of specific projects by management innovation.

5.2. Implementation path of project management of Power Grid enterprises under the new situation

Combined with the innovative optimization principles and ideas of project management of power grid enterprises under the new situation, this study constructs a project management value system based on stakeholders, effectively realize the maximum needs of project stakeholders with the optimal resource allocation, and realize the optimal allocation of various tangible and intangible resources. As shown in the following figure, the power grid enterprise project management value system is composed of enterprises, society, customers and subcontractors / suppliers. During project management process, enterprise project management value goal is to improve project implementation performance, improve enterprise management capacity, increase enterprise income, promote employee growth; customer project management value goal is to save project investment, successfully realize project value and obtain good cooperation experience; social project management value goal is to avoid contradictions

and conflicts in project implementation, promote social and economic development, subcontractor / supplier project management value goal to improve technical management level and win long-term strategic partners.

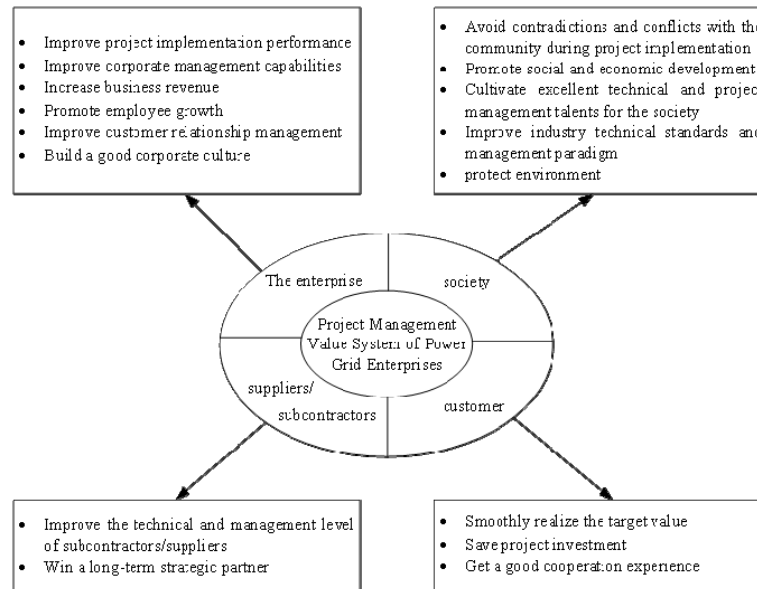


Figure 2. Project Management Value System of Power Grid Enterprise

In order to further quantify the value system of stakeholders, the study identified project management value indicators related to stakeholders by consulting literature and consulting relevant experts in the power industry, as shown in the figure below.

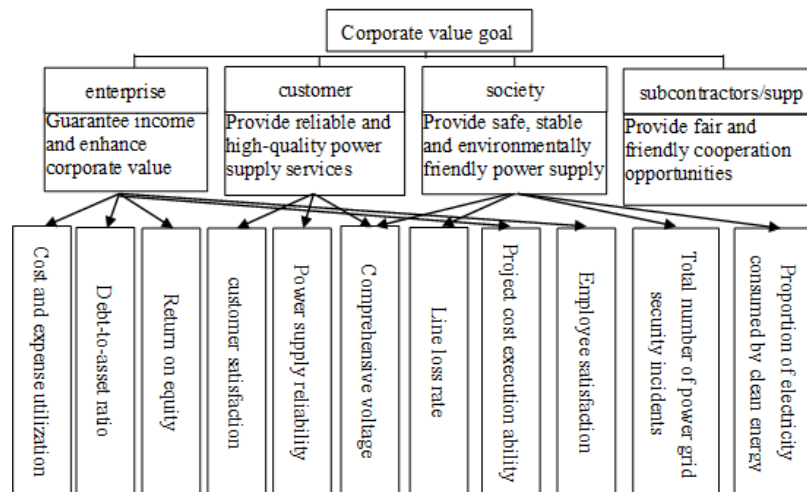


Figure 3 Value quantification indicators based on stakeholders

Based on the project management objectives of enterprises, society, customers and subcontractors / suppliers in the project management value system of power grid enterprises, we can quantify the value of stakeholders to ensure the interests and pertinence of project management and operation.

By the above research results, the project management system of power grid enterprises is determined as the "543" project management value system. "5" expresses five stakeholders including businesses, customers, suppliers, subcontractors, and society. "4" means financial dimensions:

stakeholder, internal process and learning and growth dimensions. “3” shows three levels: Data levels, decision-making level and application level.

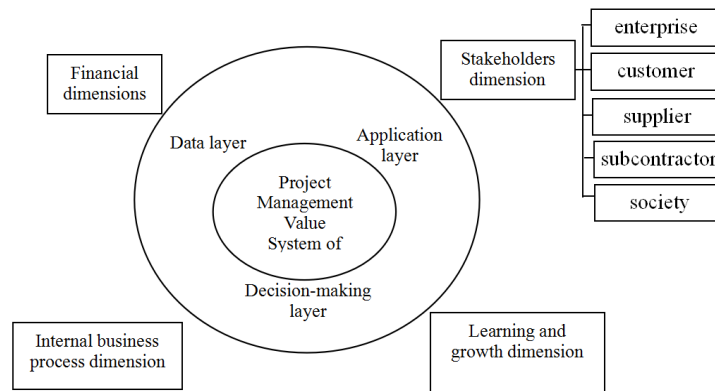


Figure 4 Overview of the 543 Project Management Value System

In order to further refine the project management and clarify the focus and construction direction of the project management for the power grid enterprises, this research builds the indicators affecting the project management value, as shown in the figure below. By clarifying the specific indicators of the financial dimension, the stakeholder dimension, the internal business process dimension and the learning growth dimension at the data level, application level and decision-making level, we provide a clear direction for the optimization and reconstruction of project management to ensure the maximum value and realize the overall planning of project management.

6. Research Conclusion

This study makes a comprehensive analysis of the transformation and development of power grid enterprises, analyzes the new forms and characteristics of the transformation, determines the change and innovation trend of project management under the new situation, bases data cognitive horizon model, analyzes the value elements of project management, determines the level and dimension of grid management, and establishes the project management system as "543" project management value system. It includes five stakeholders including enterprises, customers, suppliers, subcontractors and society. There are four dimensions: financial dimension, stakeholder dimension. There are four dimensions: financial dimension, stakeholder dimension, internal process dimension and learning and growth dimension. From data level, decision-making level and application level it provides a clear direction for power grid enterprises to reshape the project management system, and to realize the goal of informatization, standardization, intensification and flattening in power grid enterprise project management.

Based on the results, this future research direction will focus on three aspects: data governance, strict decision-making process and optimization of system architecture. First, combined with the construction requirements of the three energy Internet systems, centering on the "what to build, how to build, who to build", focusing on the difficulties and bottleneck of construction application, from the physical layer, control layer, information layer, value layer to deepen research, build energy wisdom service, energy data sharing platform, establish a standard system and other specific measures to accumulate experience and promote the high quality development of energy Internet. Secondly, strictly follow the decision-making process, research the core elements and characteristic of requirements, reserves, planning, execution, and evaluation of project management, and explore the establishment of power grid precise investment management system. Finally, explore how to adopt blockchain-based energy cloud platform to join all parties, break data barriers, optimize the system architecture to realize data sharing and data storage of the whole industrial chain.

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