



Proceeding Paper

How Digital Technology Can Reshape the Trust System of Engineering—Taking Beijing Daxing International Airport as an Example[†]

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[†] Presented at the 2023 Summit of the International Society for the Study of Information (IS4SI 2023), Beijing, China, 14–16 August 2023.

Abstract: Digital technology has broken the traditional “individual–system” trust dichotomy and has brought in a new “increment” of trust state to society. Taking an engineering project as an example, the key to a successful digital design, digital construction and digital operation is that digital technology has built an inclusive trust system and coordination mechanism in the whole life cycle of the project. In this process, the integration of the people, technology and system has broken the dimensional barrier of “man, machine and object” in the project, which not only exceeds the dependence on traditional individuals and systems, but also reduces the cost of system operation and improves the efficiency of project construction.

Keywords: digital trust; smart engineering; credible behavior; digital governance

1. Introduction

Digital technology has reshaped personal relationships, organizational docking methods, social interaction patterns and the contact between systems, which is worth exploring. This study takes Beijing Daxing International Airport as a case study to explore the digital trust system in mega projects. Mega projects have a profound impact on the country and society. Pre-research, planning, design, construction and operation often proceed for several years until completion. It is necessary to solve a number of trust problems among heterogeneous subjects that cross fields, disciplines, regions and institutional boundaries. How can digital technology play an active role in the project, reduce the cost of system operation and improve the efficiency of system operation? How can huge and complex projects be built upon diversity, inclusiveness and mutual trust? This paper attempts to answer these questions and understand the logic of digital trust construction in the current social operation.

2. From Traditional Trust to Digital Trust

2.1. What Is Trust

Trust is usually summarized as individual trust and system trust. The former relies on blood relationships and intimate relationships, which together is called particularism trust. The latter relies on impersonal communication media such as currency, rules and contracts, which is called universalist trust [1]. In the past, the economic operation, with its foundation rooted in the blood community, represents the trust of particularism [2]. In the modern society, the dependence on individual trust has changed to the dependence on system trust [3]. As the basic components of the system, various institutions have assumed the function of building trust. This reduces the interdependence between people [4]. The trust in modern society gradually turns into institutional trust based on rules, contracts and



Citation: Wang, Y.; Wang, D. How Digital Technology Can Reshape the Trust System of Engineering—Taking Beijing Daxing International Airport as an Example. *Comput. Sci. Math. Forum* **2023**, *8*, 91. <https://doi.org/10.3390/cmsf2023008091>

Academic Editors: Zhongzhi Shi and Wolfgang Hofkirchner

Published: 24 October 2023



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authority [5]. Institutional trust is no longer confined to the society of acquaintances, but it extends to the society of strangers with unlimited time and place, even without requiring emotion or repeated verification [6].

2.2. Digital Trust in Smart Engineering

Daxing Airport, as a national key project, is the largest single terminal in the world. There are many investment and construction participants in the engineering community, involving many issues across multi-level functional departments, Beijing–Hebei provincial boundaries, comprehensive transportation hubs, military airspace, environmental governance and so on. Daxing Airport has applied a large number of digital technologies to the engineering design, construction, management and operation practice, thus breaking the trust barriers between organizations, establishing a mutual trust mechanism for efficient communication, improving the management level of the project, effectively saving costs and shortening the construction period.

3. Trusted Media: Disruptive Computing Power

Compared with the human brain, digital technology has strong performance in accuracy, stability, safety, operability and cost. When the presets and risks in engineering design, construction and operation can be clearly and rationally calculated, tested and evaluated by digital technology, it means that digital technology plays an important role in the whole engineering process as a “trusted medium”.

3.1. Efficient Portrayal of Digital Design

The design team of Beijing Architectural Design and Research Institute Co., Ltd. (BIAD) (Beijing, China) and China Civil Aviation Airport Construction Group Co., Ltd. (CACC) (Beijing, China) integrated various resources, built a “collaborative design platform”, and coordinated extremely complex design organizations in a “1-to-N” docking way, making all teams break down completely independent barriers.

3.2. Precisely Control in Intelligent Construction

The Daxing Airport construction site, based on BIM, connects the interface between machines and computers, manages a large amount of very complex engineering equipment. Numerical control machines, laser cutting devices, 3D printers and construction machines are used to realize the assembly of building components under the support of CAD, BIM and integration, and they achieve the high-precision production of building structures.

4. Trusted Connection: Reshaping the “Human–Machine Object” Interaction Mode

Based on the basic logic of digital technology as a trusted medium, a new digital link has taken place in the interaction mode between “man, machine and object”: people have been given a digital identity, objects have been labeled with digital logos, and machines have been input into digital programs. This new digital connection has been widely used in smart projects, completely rewriting the interaction mode between “human, machine and object”.

4.1. Create an Environment of Mutual Trust

Multiple design subjects have successfully realized the collaborative work by using BIM. Everyone shares a common language and draws the same picture. The collaboration platform has expanded the communication channels of interpersonal information in the organization, improved the communication efficiency, and broken down the communication barriers between different design teams. The collaboration platform has given each participant a trusted identity and created a good environment for mutual trust.

4.2. *Breaking the Shackles of the Construction Site*

The construction site is full of various “sense of scene” and “sudden” problems, and the traditional construction site cannot test the “uncertainty” in advance. Digital construction significantly improves labor productivity and material management. It not only opens up the reliable connection between staff and materials and machines, but it also realizes the efficient management and allocation of engineering resources.

5. **Trusted Action: A New Digital Governance Mechanism**

Digital technology can build a more trusted, transparent and efficient actor network in engineering construction, thus breaking the loose connection of traditional design, construction and operation.

5.1. *Digital Technology Strengthen the Enforcement of Rules*

Digital design and construction strengthen the enforcement of rules and regulations. In this way, the whole project will become easier to control, and the design and construction process will become more rule based and controllable. Digital technology supports energy management, provides environmental protection via a monitoring system, supports engineering synchronous statistics system, and strengthens the enforcement of financial and asset management systems.

5.2. *Digital Perspective on Labor Process*

Complexity is a word that has been viewed in a negative context for a long time, which often leads to an uncontrollable increase in project difficulty and potential risks of cost and time. In order to cope with the above risks, Daxing Airport firstly uses BIM data visualization technology to realize the digital construction and quality management of an airfield in China, and secondly, it applies BIM to a large-scale terminal design. All design details and processes are clearly displayed in the form of a 3D model.

5.3. *Digital Foresight Removes Risks*

Digital verification is more persuasive than experience and standard judgment. It is a kind of knowledge stored outside the brain, which does not need human brain processing, but only requires the user to execute it and wait for the results. Daxing Airport has verified the design requirements of various functions by using digital verification such as the simulation of pedestrian flow, structural load analysis, light environment analysis (lighting and shading simulation based on BIM model), and CFD (outdoor wind environment simulation based on BIM model).

6. **Conclusions**

All kinds of trust subjects in the project can establish a new trust mode based on the data automatically transferred on the intelligent platform, thus avoiding the loopholes in management and reducing the complexity and transaction costs. All kinds of trust subjects are no longer limited to personal trust or system trust, but they are expanded to the stranger society with unlimited time and place. In general, the digital embedding in the project not only strengthens the individual trust and system trust, but it also reshapes the trust system.

Author Contributions: Conceptualization, Y.W. and D.W.; methodology, Y.W. and D.W.; investigation, Y.W. and D.W.; resources, D.W.; writing—original draft preparation, Y.W.; writing—review and editing, D.W.; supervision, D.W.; project administration, D.W.; funding acquisition, D.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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