

論文の内容の要旨

論文題目

ORGANIZATIONAL ROBUSTNESS IN PROJECT BASED TECHNOLOGY DEVELOPMENT: International Comparative Case Study on Fire Prevention Technology Development

(プロジェクト・ベースの技術開発における組織のロバストさに関する研究: 防火技術開発に関する国際比較ケーススタディ)

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In order to develop modern methods, advancements or technological improvements in the construction industry first, the key technical and organizational capabilities must be understood well. It is significant but a complicated issue to define the essential environment that is required by the aimed technological development. In this research "*Organizational robustness in technology development*" is defined as an integrated structure of the players' organizational capabilities that is measured by its effects on the project. Accordingly, evaluation of the organizational robustness in technology development projects has merits to assess potential abilities and disabilities that support risk avoidance activities and preparedness.

The objective of this research is to propose Criteria of Benchmarking to define and to examine the main key indicators of technology development in the construction industry. The proposed methodology stands on the fundamentals of "*Robustness Equilibrium Theory*" that is developed within this research. This theory analyzes the principles and necessities of technology development in different business cultures by focusing on the interdependent relationship of capabilities. RE theory summarizes principally observed phenomena through these words;

"There is a certain degree of interdependent balance among organizational capabilities in robust projects that can be explained explicitly".

In some point RE theory extends the RPP (Resource, Process, Priority theory developed by Christensen, M.C. and Kaufman, F.P.) theory to a dimension where component capabilities are quantitatively measurable. In respect to the principal logic of the RE theory the main hypothesis of this research is;

"No matter the independent changes, robust projects emerge on interdependently balanced capabilities under the groups of Resources-Process-Priorities."

Additionally, the epistemology of this research is particularly influenced by the positivist approach of Karl Popper through the empirical analysis part of the research. However, the falsifiability of the RE theory is checked by an interpretative approach through an experimental application. The epistemological stance of this research doesn't support rational objectivity because developing a generalized law is not the main objective of this research.

In order to check the applicability of the RE theory, it is experimentally applied on the development of fire prevention technologies in high-rise building projects from Japan, the UK, Germany and Turkey. In this research the scope of fire

prevention technology development is specified by the developments in active fire prevention devices, components, equipments, etc. that are the interoperable extensions of Building Automation Systems. Moreover, this research studies fire prevention technology development cross-disciplinary such as advancing fire detection and communication equipments by technology fusion with numerous improvements in IT. On the other side, regarding the significant effect of cultural patterns, government's role and regulatory environment international comparative analysis provided a wide perspective for to observe the phenomena.

Considering the above mentioned focuses in this research the precise description of the objective is as below:

“Main objective of this research aims to propose Criteria of Benchmarking that contributes to define and measure organizational robustness in active fire prevention technology development.”

As for the methodology of the research, it is a synthesis of theoretical surveys followed by empirical analysis and discussions on justification of the findings. The theoretical survey part of the research helped to narrow down the focus of the research and finally conclude with a proposal of RE theory. Empirical surveys are realized with practitioners through two sequential steps: 1) Semi-Structured Interviews and 2) Questionnaire Surveys.

Through the semi-structured interviews the key capabilities of fire prevention technology development in high-rise building projects are determined and different patterns of role, process and knowledge flows that take place during technology development projects in construction are disclosed.

Analyzed major findings derived from the interview surveys were utilized to design the questionnaire survey. As the main aim of the questionnaire survey the interdependent relationship among the key capabilities were revealed and upon the findings ideal RE among the key capabilities of fire prevention technology development was modeled for the each case country. Furthermore, through quantitative analysis potentially vulnerable key capabilities in fire prevention technology development business are disclosed and actual RE for the fact in each case country is modeled. Analyzed survey findings proposed Criteria of Benchmarking for the each case country. The Criteria of Benchmarking that are established for four countries in this research aimed the interest breadth of practitioners who are in the system integrator position (*Zenecon* in Japan, PM in UK, PM and Main Contractors in Germany and Main Contractors in Turkey) and policy makers (government authorities who has a very significant role in technology development in construction).

The reliability of the Japan case Criteria of Benchmarking accordingly the reliability of the RE theory is checked through t-test on random samples and by experimentally applied on 1 sample case.

According to the international comparison of the findings about the RE models the most potentially robust patterns in capability intensity is observed in the Japan case. The patterns of potential vulnerabilities and robustness in Japan and Germany cases showed significant similarities. In addition to the similarities differences are observed to be caused by the potential vulnerabilities in Process related capabilities in the Germany case.

Moreover, the UK and Turkey case also showed significant similarities in the intensity of RPP elements and in the perception value of three main fire safety

design concerns that were: 1) General Technology Development Principals (GTDP) 2) Active Fire Safety Design 3) Passive Fire Safety Design. Findings showed the highest perception value for the each concern in Japan case. Interestingly, in each country the GTDP showed the highest consideration.

The gap between the Importance value and Weighted Actual Intensity value of the key capabilities in practice is found to be the largest in the Germany case while Japan case showed the most considerably overlapping pattern among the cases. The UK and Turkey cases showed similar patterns due to the similar business model: role and process flow similarities of fire safety design in high-rise building projects. Major findings from each case are displayed together on an international comparative platform. Diversities in business cultures between the case countries were emphasized as well as disclosing how the same organizational capabilities functionally behave and contextually mean different in each case. Besides, the affects of regulations and government's role (as being an obstacle or motivator of innovations) in fire prevention technology development was discussed. Findings might have a potential contribute to learning an international lesson and arouse reform suggestions.

Consequently, according to the findings of this research apart from the experimental application of the RE theory there is a need of further research in the scope of empirical verification of the RE theory and verifications of the proposed Criteria of Benchmarking are needed.