

THE MANAGEMENT OF RULES AND PROCEDURES IN CONSTRUCTION COMPLEX SYSTEM

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1 SUMMARY OF THE PROPOSAL (Paper)

The complexity involved in the construction processes, causes the existence of a high degree of unanticipated variability in these systems. Theories of Resilience Engineering and Lean Production aim to reduce the variability through standardization of work, developing operational work standards that can provide greater stability to the system, improving the production and safety management practices, for example. Although both theories had the same goals, also have different perspectives about work standardization. This paper firstly presents a discussion about the complementarity and synergy of both theories. After this, is presented a partial application of rules management proposed by Hale and Borys (2013b), in an engineer to order (ETO) company.

As an object of this empirical study was chosen the semi-space truss assembly process for building systems (Figure 1), which were studied four different operational teams in different contexts. This empirical study has the following division into stages: **stage (i)**, existing and current processes and rules were analyzed; **stage (ii)**, it is the development of a protocol for evaluation and validation of existing rules; **stage (iii)**, refers to redesign the existing rules; **stage (iv)** is the definition of processes, risk and control scenarios, based on practical analyzes. The rest of the steps of the method proposed by Hale and Borys (2013b) will be developed in the future, because research is still in progress.

Semi-space truss assembly process for building systems



- **Stage (i):** A rules surveys were made in company work standards (projects, procedures, training manuals, etc.), in order to understand, about the company viewpoint, how processes should happen.
- **Stage (ii):** At this stage, field surveys were done in 4 different contexts, using film records, photographic registers, process diagrams (Ishiwata) and interviews with workers and engineers. The purpose of this stage is summarized in understanding how the processes were developed in practice. Finally, a comparison were made between team's performances and the existing rules.

- **Stage (iii):** In this stage, we developed a data collection protocol that was applied to the company's experts (engineers, managers and experienced workers), in order to validate the best practices implemented by the teams and identify the deviations of the established rules, giving subsidies to the development of resilient work standards.
- **Stage (iv):** with all the contributions of the earlier stages, processes and operations have been defined, more appropriate to the contexts. All specifications were exposed in work standards suitable to workers, as well as process control tools.

As a summary of the results, the study shows that, despite being a semi-industrialized process with pre-molded parts, experienced teams and a certain content rules, the context in which the process is inserted is crucial in order to follow the work standards. Despite being the same process, all teams had particularity in production operations, logistics, safety management, etc., caused by non-technical skills and enhancing resilience of the system to combat the constraints caused by the complexity. In fact, that the different ways of performing operations, indicated the presence of unanticipated variability in the system. Thus, the proposed framework and its implementation in stages, combined with Lean tools, contributed to the absorption of these resilience skills by the company, where it was possible to develop work standards more targeted to the contexts, with a higher specification, and at the same time, more flexible. In addition, the gaps between the operation and the work standards can be controlled and managed, resulting in significant contributions to formation of RS's.

2 RELEVANCE FOR SYMPOSIUM

The topic discussed in this paper is strongly related to the theme of the symposium. The standardization of work in construction sites, considering the principles of Resilience Engineering and Lean Production, presents a synergy and some benefits by reducing the degree of unanticipated variability, providing detailed specifications (rules) about the actions to be developed by the workers, reducing the gap between SOP's and itself operation. Thus, the idea presented in this paper is based on the empirical combination of application of the principles and methods of RE with LP principles and tools to work standardization. Highlighting also, the complementarity of the two perspectives, important for dissemination of RE applicability in not largely explored contexts, however, very promising as the construction, identifying new learning opportunities.

3 SIGNIFICANCE/TAKEAWAY:

Some studies in construction have shown that the work standardization on the perspective of Lean Production, despite being widespread and concrete, when applied to construction context, it shows incomplete and not as effective when compared to industrial systems. This paper approaches this gap by demonstrating empirically that the application of methods and principles of RE can be complementary to the Lean Production Theory. The proposed method is tested in a specific process to a production sector of an engineer to order (ETO) company, and provides insights into its potential for rules establishment and design of balanced work standards or SOP's, considering action-rules, process and goals. This study also demonstrates the need to consider the skills and experience of several teams (since operational teams, until the specialists) involved in the processes for the development of work standards on the RE viewpoint.

4 REFERENCES

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