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Natech-RateME - Comprehensive Natech Performance Rating System: Evaluation of Current Systems and Identification of Key Elements

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ABSTRACT The paper presents a survey of existing building rating systems with different approaches. A comparison is made in order to identify key elements. The first approach for the development of a comprehensive Natech performance rating system is established. Identified criteria will help to support industrial parks to manage the onsite and offsite risk from extreme events.

INTRODUCTION Rating systems have been proposed as performance monitoring tools to evaluate progress towards a preferred state or condition. These kinds of tools have been applied in several fields such medicine, economics, engineering and education among others, as they provide a clear picture of the areas requiring further work, supporting decisions, investments and activities to be implemented (STAR 2016). Building infrastructure rating systems have had different approaches and have evolved from code designed buildings whose main objective is to protect the lives of occupants, passing through performance based design, until finally reaching the resilience-based approach (Almufti and Willford 2013). The Resilience-based Earthquake Design Initiative (REDi™) Rating System is a recent effort that provides a framework for implementing a holistic “beyond-code” design, and a planning and assessment approach for achieving seismic performance.

In the evolution process, sustainable infrastructure rating systems have also emerged by the need to go beyond a purely structural analysis and incorporate three main aspects, economics, environment and social responsibility. The latter is known as the Triple Bottom Line (TBL) and its main objective is to support community long-term interests (Diaz-Sarachaga, Jato-Espino et al. 2016). More recently, in order to tackle the high energy consumption and environmental impact by the construction industry, green building rating systems have been proposed.

Among the different approaches previously mentioned, the REDi framework seems to fit very well the complex nature of Natechs, where there is a need to rate improvements towards risk reduction goals, while strengthening business continuity and territory resilience. Nevertheless, a deeper analysis that considers the different approaches is required.

KEY ELEMENTS AND DISCUSSION Nowadays there are various types of rating systems (RS) being implemented worldwide. The diversity of approaches makes the selection of relevant systems to be analyzed, and their comparison, a difficult task. Thus, a screening procedure was employed following the ideas of (Zezhou, Liyin et al. 2016). Four criteria are considered: relevancy, availability, current use and measurability. Ten rating systems were selected for the analysis. Categories and subcategories, use of weights and/or percentages, types of certifications granted, and indicators used where compared. Table 1 shows the main characteristics for each rating system. Categories for the Sustainability rating systems refer to the ones established for New Construction/Building. It can be seen that a wide number of subcategories are considered among the ten RS. This issue has not received much attention, but a greater subdivision of categories may decrease sensitivity, decreasing the importance of aspects considered as the contribution

***Table 1**. Comparison of Ratings systems in different fields*

Framework name	Acronym	Approach	No. Categories	No. Subcategories
Resilience-based Earthquake Design Initiative	REDi™	Resilience-based design	4	16
Civil Engineering Environment Quality	CEEQUAL	Sustainability Infrastructure	9	48
Infrastructure Sustainability	IS	Sustainability Infrastructure	6	15
Envision (ISI)	ENVISION	Sustainability Infrastructure	5	60
Leadership in Energy and Environmental Design	LEED	Green Building	9	48
Building Research Establishment Environmental Assessment Method	BREEAM	Green Building	10	55
Green Globe	GG	Green Building	7	44
Chinese Evaluation Standard of Green Building	ESGB	Green Building	6	83
Green Building Index	GBI	Green Building	6	51
Comprehensive Assessment System for Built Environment Efficiency	CASBEE	Building Environmental Efficiency	6	20

they have tends to be increasingly insignificant, finally affecting the uncertainty of the tool and, at the end modifying the distribution of probabilities (Parry 1996). In the context of Natech scenarios, the complexity of the system can result in higher uncertainties. Thus, in order to assess subjectivity and deepen in the analysis, a methodology such as Monte Carlo, Direct Ranking Method and Analytic Hierarchy Process can be implemented (Chandratilake and Dias 2013). On the other hand, there is consistency across the categories established in the various rating systems analyzed with Energy, Water, Materials, Indoor environment and Management among the most common to all systems. This shows the importance of lifeline systems supply in any context, particularly in extreme scenarios where these systems are likely to be unavailable. Thus, lifeline system availability is an important issue to be considered in the development of a Natech performance rating system. Resilience seems to have been left out in most of the frameworks. Envision, BREEAM, IS, and CEEQUAL consider resilience to a certain extent, however, only REDi RS's approach is mainly focused on resilience and the capacity to restore and resume normal activities after an earthquake.

CONCLUSIONS Considering the analysis of sustainability and building rating systems, key elements that can be applied in the context of Natech scenarios have been identified. Lifeline systems supply, resilience and business continuity are found to be among the most relevant aspects that should be considered. Organizational, Infrastructure, Ambient or Environment and Governance are established as the most indicated main categories for the new rating system. The establishment of subcategories needs further work, but considering uncertainty as an issue of main concern, the number and characteristics of these should be kept as simplified as possible.

Finally, it is important to mention that the rating systems considered are only focused on earthquake and/or flooding and therefore, extending the analysis to other types of natural hazard scenarios is needed.

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