# Teaching Domain-Specific Requirements Engineering to Industry

## Applying Lego Serious Play to Smart Grids

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***Abstract*— Within this contribution, we present an approach developed in order to communicate Smart Grid Systems Engineering as well as architecture management to domain-specific industry stakeholders from utilities. The method acts as requirements elicitation process based on Lego Serious Play methods alongside the domain specific IEC 62559 use case process. Based on years of experience applying the classic RQE approaches in the domain, the methodological background of the new tooling as well as the initial decisions for the process to be implemented are presented.**

## I. Introduction to the Scope

Within this contribution, we elaborate on the use of Lego Serious Play methods in the context of domain-specific requirements engineering within the context of industry projects. The projects under discussion were conducted with industry stakeholders in the context of Smart Grids. The presented approach is an extension to an existing requirements engineering and elicitation method which has been established in the context of Smart Grid Research and Development projects since 2009 in the context of a standardization mandate from the European Commission to the standardization bodies of CEN/ CENELEC and ETSI. While it proved very useful in the initial scope and discussions with standardization experts, the purely document-based method regarding the elicitation process as a documentation issue instead of an understanding issue has recently become part of the focus of interest.

We briefly introduce the IEC 62559 Smart Grid Use Case template with its corresponding processes as well as the connection to creating architecture models based on the SGAM model. In addition, we will reflect on the state-of-the-art applying those methods and the feedback from the stakeholders involved. Based on this feedback, an approach to facilitate better understanding of the requirements has been implemented by the authors, taking into account the knowledge management dimension of the elicitation process.

The remainder of this paper is organized as follows. First, we briefly introduce the standardized state-of-the-art in Smart Grid requirements engineering. Afterwards, we elaborate on the feedback gained and challenges for this very process. Based on the challenges imposed, our approach to deal with them is presented, using the Lego Serious Play (LSP) approach as a basis for the elicitation process. The abstract closes with a short overview on initial conclusions as well as future work to be done.

## II. Smart Grid Methods: IEC 62559 and SGAM

For Smart Grid project management purposes, it is important to describe use cases and their functionalities in a structured and organized way [2, 6]. This process for Smart Grid solutions is called use case methodology by EPRI and is specified as a template in the standard IEC 62559-2 by IEC TC 8. The other three parts of the standard series IEC 62559 – Part 1, 3, and 4 – classify the Use Case Methodology as well as a possible tool-support. The IEC 62559-2 is based on a word-template with a fixed structure of formal information to be filled out by the requirements engineer and stakeholder and was promoted in the M/490 mandate of the EC. More than 400 standardized use cases were elicited in the mandate [3, 4]. However, as it is purely text based, with only use case and sequence diagrams, the SGAM was created to show the emerging technical architecture of a use case. The Smart Grid Architecture Model (SGAM) has been developed as well in the course of the EU Mandate M/490 to European standardization organizations in order to support the Smart Grid deployment. It was developed as a part of the reference architecture framework during the work of the mandate. There, it is used to identify and characterize the power system domains, with their different zones, and the ICT systems which are relevant to this analysis with a special focus on interoperability/standardization. ICT systems must be described including the relevant technological components (such as storage, processing power and band-width) and the appropriate ICT objectives (such as resilience, maintenance, privacy and cybersecurity, and interoperability. It is based on the GridWise architecture council interoperability stack and has proven to be useful for fostering architecture discussion. However, issues with improvable RE quality remained, as discussed by van Vliet [1]. Oftentimes, the different educational background of utility people and software engineers led to implicit and tacit knowledge not being documented.

People from industry thought about architecting as a way of documenting the resulting connectors and components instead of understanding software architecture as a way of documenting and sharing important design decisions. For the process of understanding the "wicked systems" and their interdependencies, a more suitable approach has to be taken by the Engineer. Initial work on software engineering for requirements elicitation as well as security analysis has been done by [5]. The au-

thors took that work as a starting point to enhance their current best practices of the standardized process for use case management at utilities [3, 4].

## III. Lego Serious Play for Modeling Smart Grid Architectures

The Lego Serious Play (LSP) methodology is a facilitation methodology created by the LEGO Group, which is available using an Open Source, community based model.
The overarching goal of the methodology is to foster to the process creative thinking using team building metaphors of their organizational identities and experiences with LEGO-compatible bricks. Usually, participants work through imaginary scenarios using visual three-dimensional brick constructions, hence the name "serious play".

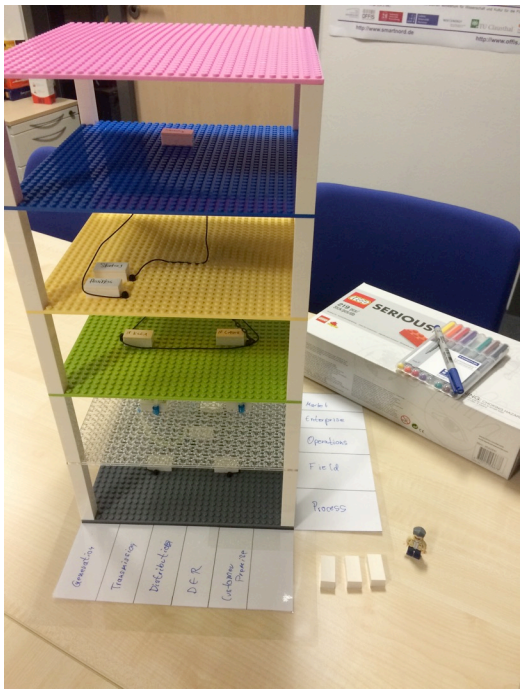


Fig. 1. Setup of the LSP model for the stakeholders.

The overall method is described by their creators as "a passionate and practical process for building confidence, commitment and insight". The LSP approach is based on research which suggests that hands-on, "minds-on" learning produces a deeper, more meaningful understanding of the world and its possibilities. It is claimed that participants come away with skills to communicate more effectively, engage their imaginations more readily, and approach their work with increased confidence, commitment and insight. Based on traps and drawbacks described by van Vliet [1], this approach proves useful to overcome the aforementioned drawbacks of the standardized process based on the IEC 62559 word template and the generation of the architecture model using the UCMR tool. Initial workshops were set-up and a meaningful set of bricks were chosen for the participants to work with. As the original SGAM is color-coded for the various interoperability layers, corresponding base plates were chosen. Simple white bricks with tiles act as systems, connectors are created using brick chains. Wipe-able pens act as possibilities for labels, color-coding of information objects exchanged exists using white, grey and red 2x4 tiles. Individual layers can be modeled as single time-based workshop items, later, the model is completed and all interoperability layers combined to an architecture model of an SGAM. The feedback from the stakeholders to create their models based on the use cases in word as well as using the brick-based LSP method sowed a general higher interest due to the use of "physical" objects being used. Oftentimes, changes did occur to a model which was usually not the case when a moderator used an UML tool with a beamer instead. As the users quickly build and re-arrange their systems, data exchanges and responsibilities for a systems and its use in a business process, more feedback is provided to the requirements engineer.

## IV. Future Work and Conclusions

Current results show more positive feedback on the process of the elicitation and, in general, a higher interest in the communicating the requirements form the stakeholders. As more and more workshops are conducted, more empirical data is gathered for evaluation purposes. Next steps include using so called misuse cases for security analysis and unintended use of systems and functions for trying to elicit the non-functional security requirements the stakeholders have already thought about.

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