

Enhancing Trustworthiness and Formalization in the Construction Industry with Modeling Languages and Ontologies

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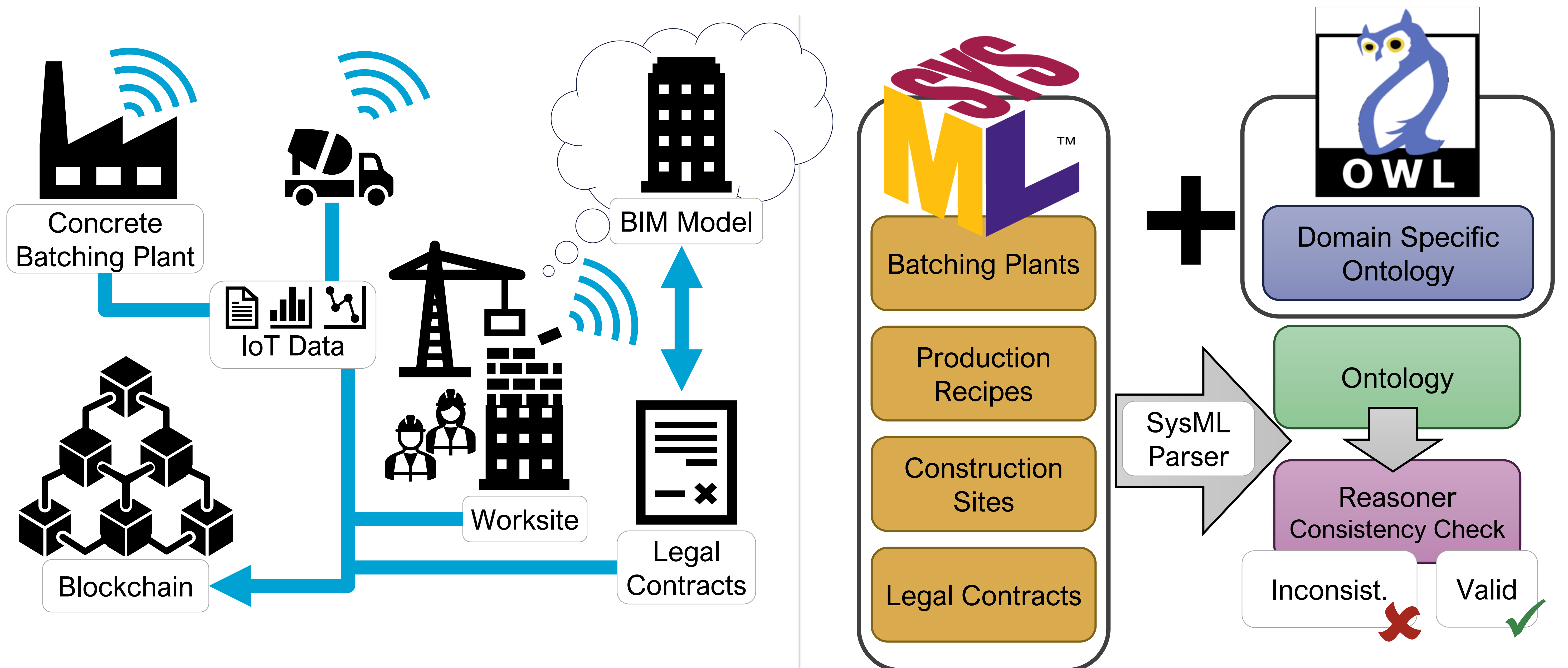
Motivations

- **Construction Industry** evolving driven by **Industry 4.0**
- Series of **challenges**:
 - **Complexity** and diverse operations in large-scale projects
 - Suboptimal profitability and **operational inefficiencies**
 - Reliance on **traditional practices**
 - **Underutilization** of modern **technological** innovations
- Ph.D. program co-funded by **Build Trust** startup:
 - Monitoring production with **IIoT sensors**
 - Real-time **tracking** of **on-site activities**
 - **Material usage** and carbon footprint
 - Permissioned **blockchain**

Background

- **Systems Modeling Language (SysML v2)**
 - **General-purpose** modeling language: textual & graphical
 - Allows to model **different aspects**
 - No longer based on UML
 - Precision, expressiveness, consistency, interoperability, usability
- **Ontology: Formal**, explicit, and machine-readable representation of **shared knowledge** within a domain
- **Semantic Reasoner**
 - Deduce new facts from existing axioms within ontologies
 - Verify the **consistency** of the knowledge base

Overview



Preliminary Results & Future Works

- Enrich SysML models with **ontologies reasoning**
 - Utilizing ontologies to **provide formal support** in plant modeling
 - Check the **consistency** and **feasibility** of production recipes
 - Validated in the Industrial Computer Engineering (ICE) Laboratory
- Integration of new features introduced by SysML v2
- Modeling of **legal contracts**
 - Monitor and verification of **contract compliance**
- Explore relationship between **Blockchain** and SysML
 - Automatic generation of **smart contracts** from models

References

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- 2) S. Spellini, S. Gaiardelli, M. Lora, F. Fummi, **Enabling Component Reuse in Model-based System Engineering of Cyber-Physical Production Systems**, in: Proc. of IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), 2021, pp. 1–8.
- 3) S. Friedenthal, **Future Directions for MBSE with SysML v2**, in: Proceedings of the 11th International Conference on Model-Based Software and Systems Engineering - Volume 1: MODELSWARD, INSTICC, SciTePress, 2023, pp. 5–9.
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Take Home Message

Model-based framework, supporting formal verification using Ontologies reasoning, may enhance system reliability and automation in complex industrial processes.