Applying Systems Thinking for Early Validation of a Case Study Definition: An Automated Parking System

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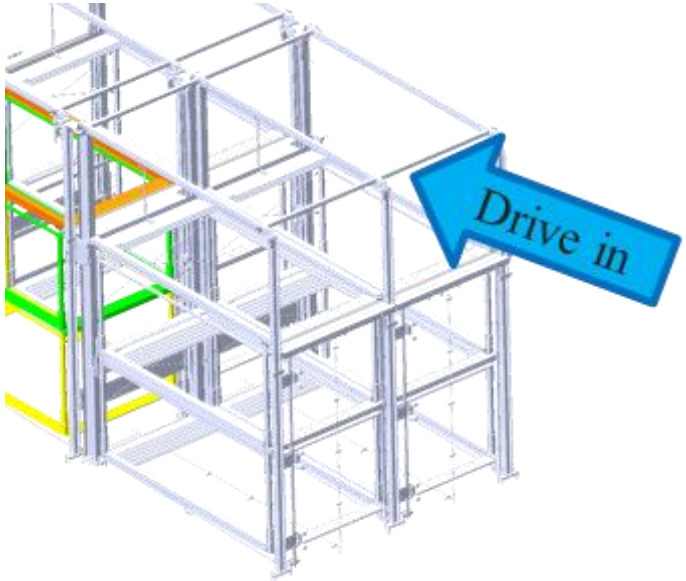
Haytham B. Ali is employed as PhD research fellow and Assistant Professor at the University of South-Eastern Norway (USN). He is working on connecting engineering with science, focusing on mathematics. Haytham focuses on his PhD at using a combination of conceptual modeling and data analysis to enhance the early design phase in the product development process. He holds a Master of Science in Systems Engineering with Industrial Economics degree and a Bachelor's degree in Mechanical Engineering with a specialization in Product Development, both from USN.

Aims of Our Study as Part of a Large Research Project

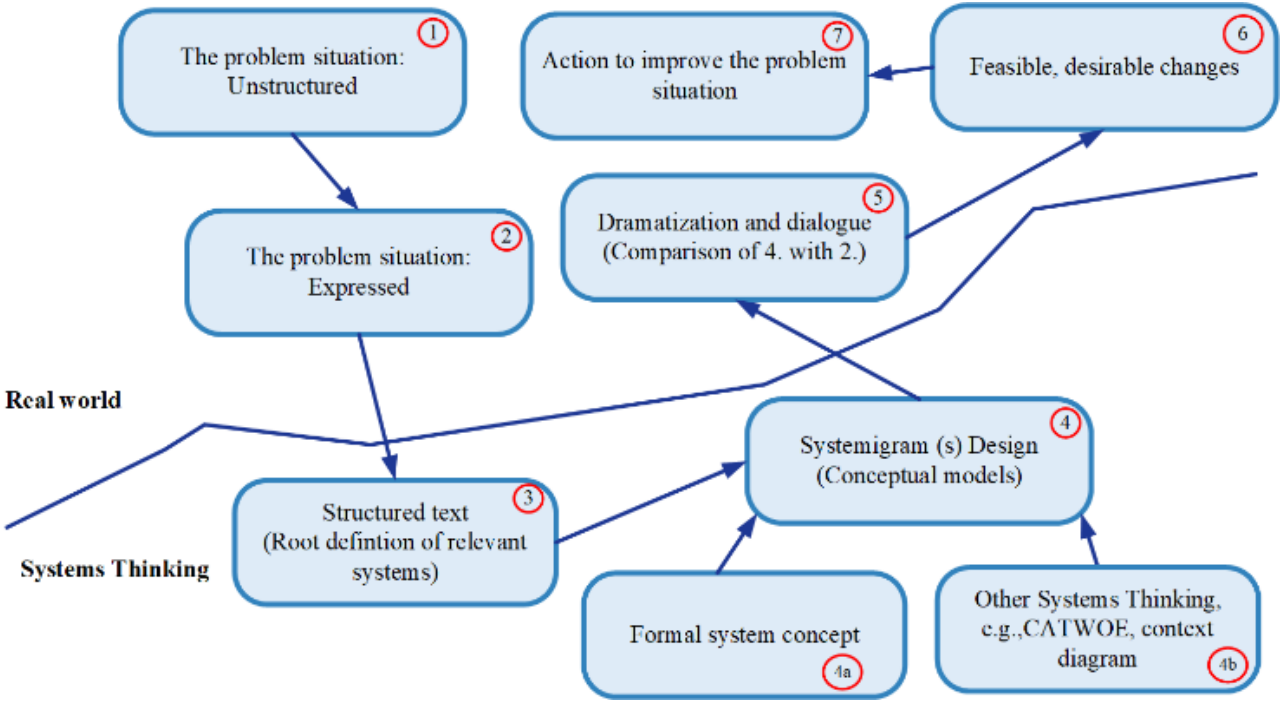
- **In our study, we aimed at:**
  - Applying systems thinking and its tools to validate the Company's need in an early phase to well-define the case study in the research project. We use systemigrams for early validation. The foundation for the systemigram is system thinking tools. These tools include stakeholder analysis, context diagram, and Customers, Actors, Transformation, Worldview, Owner, and Environment (CATWOE) analysis. Systems thinking and its tools aid in communicating and sharing a common understanding of the Company's case study and support further exploration of the value proposition for the Company's actual needs.
- **Research project**
  - This research is part of a larger research project, the second iteration of the Human Systems Engineering Innovation Framework (HSEIF-2), funded by The Research Council of Norway (Project number 317862). For more information, please visit the research website at: https://www.usn.no/english/research/our-research/technology/norwegian-industrial-systems-engineering-research-group/h-seif-2/

System-Of-Interest (SOI)



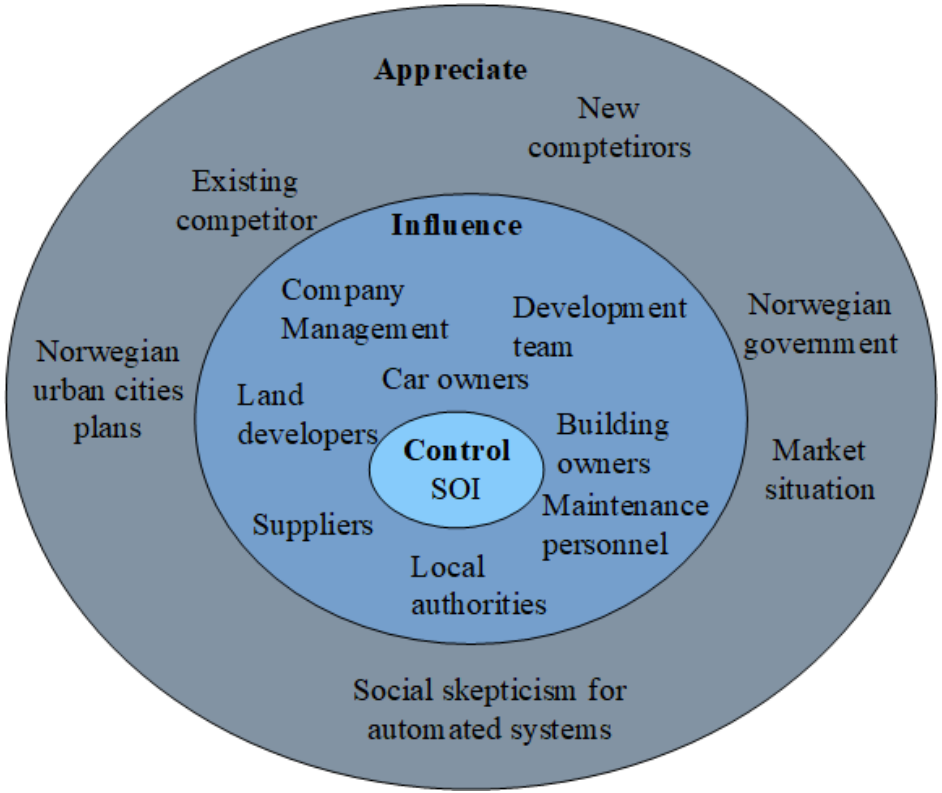
The SOI: the semi-automated parking system.

Research Method



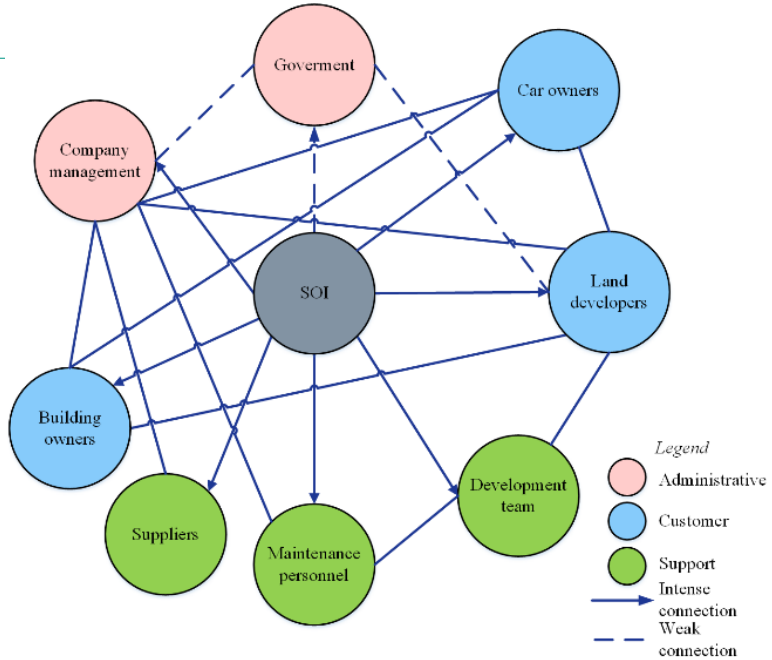
Checkland's soft systems methodology (SSM)

Context Diagram



Context diagram of the SOI.

Stakeholder Analysis



Stakeholder interests map.

Stakeholder	Interests (why)
Government	Urban city development, including building new buildings and car-free downtowns. The government has the authority for regulation and standards for the SOI and includes the Norwegian Competition Authority
Company management	A reliable SOI as the traditional parking system, customer satisfaction, profit maximation
Land developers	Operating Expense (OPEX) and Capital Expenditure (CAPEX)
Building owners	Operating Expense (OPEX) and Capital Expenditure (CAPEX)
Car owners	Availability of parking spots and reliability of the SOI (getting the right car without any damage at the right time)
Suppliers	Maximize profit by winning contracts and satisfying the Company, which is the supplier's customer
Maintenance personnel	Accessibility and usability of the SOI to conduct maintenance
Development team	Accessibility and usability of the SOI for car owners and maintenance personnel or anyone who uses the SOI

Customers, Actors, Transformation, Worldview, Owner, and Environment (CATWOE) analysis

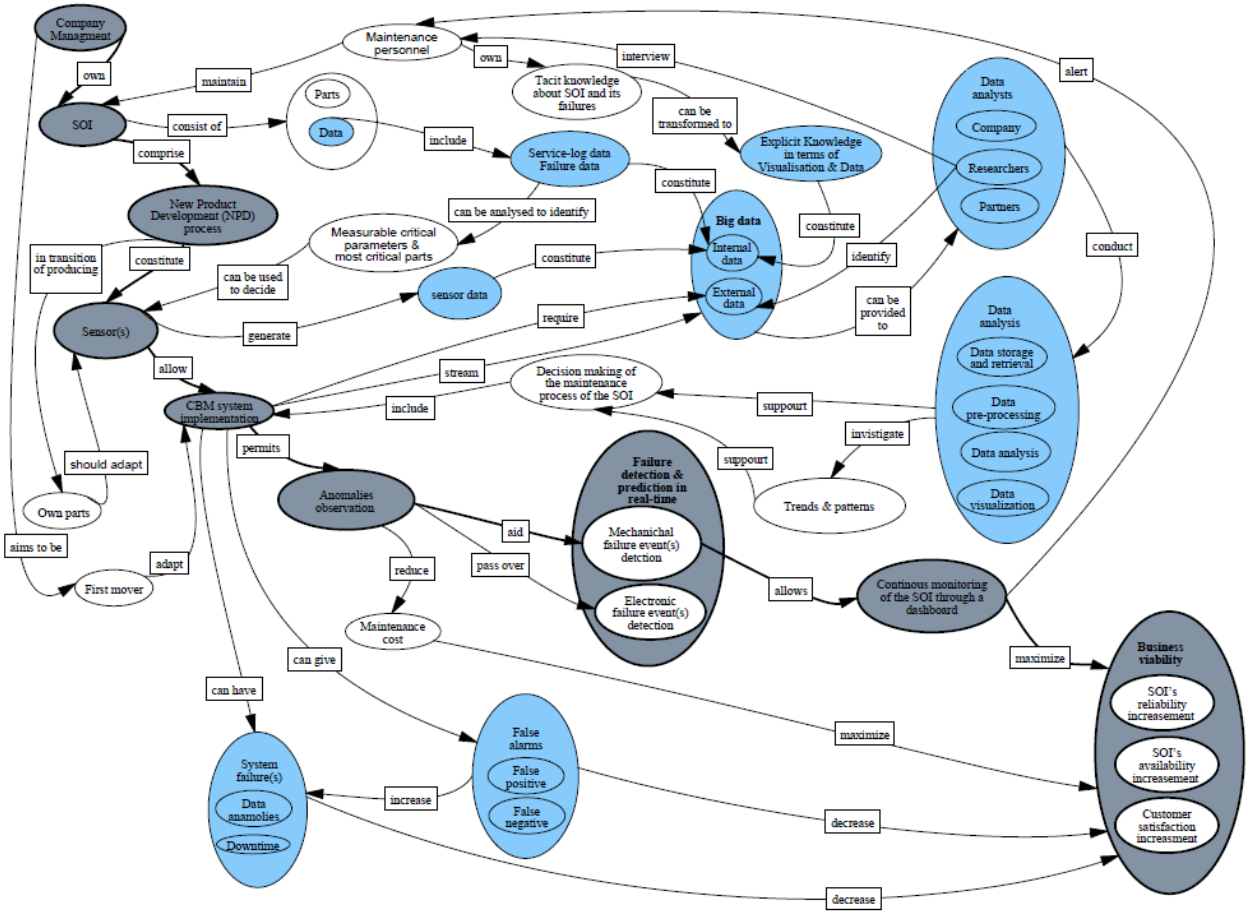
Aspect	Description
Customers	Company management
Actors	Partners, suppliers, maintenance personnel
Transformation	Increase the reliability of the SOI
Worldview	H-SEIF2 research project: value from big data (provide data to the project) Maximize profit
Owner	Company management
Environment	Urban cities

CATWOE: COMPANY MANAGEMENT

Aspect	Description
Customers	Maintenance personnel
Actors	Suppliers, Company management, car owners
Transformation	Maintenance process and method
Worldview	Increase reliability and availability of the SOI
Owner	Department heads of service and maintenance
Environment	The Automated Parking System (APS), building, cars, traffic density, weather, city infrastructure

CATWOE: MAINTENANCE PERSONNEL

Systemigram



Conclusion

- Defining a case study well within the early phase of a complex sociotechnical research project is crucial for its success.
- This success can be measured by the Company's active participation and trust by sharing all needed data.
- We applied systems thinking and its tools to a real-industry case study. The tools include stakeholders' analysis, context diagram, CATWEO analysis, and systemigram.
- This application aims to validate the Company's need early as part of defining the case study well, including its several unit analyses.
- Feedback on the application of systems thinking methodology and its tools indicates that systems thinking aids in communicating and sharing understanding of all aspects and critical stakeholders' perspectives within the case study. This early validation helps researchers (academia) and Company (industry) investigate the Company's need and what triggers such a need to further explore the real needs of the Company's case study.

Thank You

Q & A