ORGANIC COMPUTING

Universität Augsburg University

Autonomous Self-Integration in Interwoven Systems

INTER WOVEN SYSTEMS

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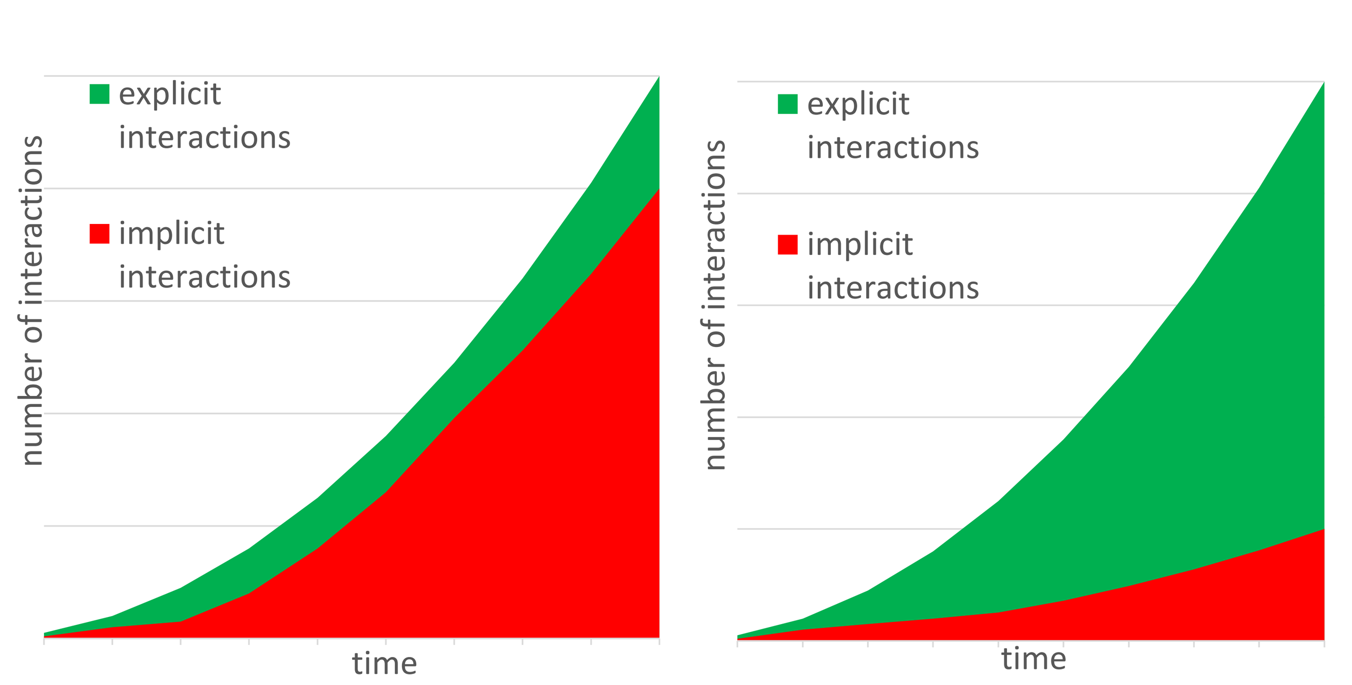
Research Question on Interwoven Systems (IwS): How can we control and manage connected and coupled systems that were initially not meant to interact with each other?

Definition and Research goals

Today´s technical systems, containing ICT (Information and Communication Technology) components, have become of tremendous complexity. They are no longer isolated but increasingly interfering and becoming ***interwoven*** with each other.

So-called implicit interactions are leading to unanticipated, ambiguous, or even malicious behaviour. We will propose to equip systems with so-called explicit self-integration capabilities in order to cope better with situations that were not foreseen at the systems' design-time with **Self-Integration** at runtime.



Left: Uncontrolled growth of IwS: more implicit interactions
Right: Self-integration will show more explicit interactions

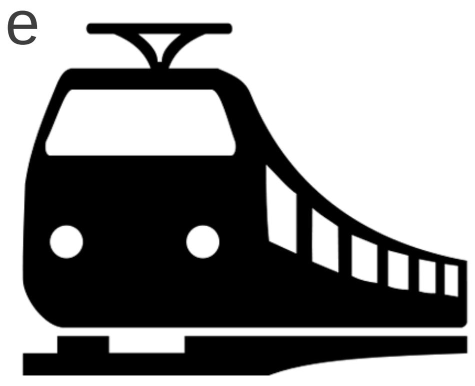
Self-Integration

- **Self-adaption of behaviour**: The internal control mechanism of the system alters the configuration of the productive strategy according to observed changes in the environmental and internal conditions.
- **Self-management of relationships**: The system itself decides about its cooperation partners – by adding and removing relations to other systems, the overall system is re-organised. As a result, the structure of the system is adapted at runtime.
- **Quantification of success**: Besides performance-related metrics, subsystems need a quantification method to estimate the success of the integration status. Further influences have to be taken into account, e.g. reliability of interaction partners, availability of resources, or redundancy to avoid outages.
- **Self-modelling**: As basis for the decision process, subsystems have to generate and update models of themselves, their surroundings, and their (possible) interaction partners, including dependencies and transitive processes among them.
- **Technical Trust**: Closely related to modelling is the capability to establish (technical) trust relationships. Based on observations of historical behaviour, estimations are derived how interaction partners will behave in future situations. This is especially important in open, heterogeneous systems.
- **Flexibility and goal adaption**: Subsystems need the freedom to reflect about their current goal and strategy – also allowing them to accept non-optimal states for a certain period.

Example: Railway system

Until about two decades ago, the German rail system was run as a public institution operating all trains and the rail network itself.
The formerly integrated national railway operator was split into an infrastructure manager and railway undertakings for freight services, long-distance passenger services, and local passenger transport.
Today, a large variety of business models is applied in the German railway market.

The rail system is an example of a system of heterogeneous, geographically distributed subsystems with a high degree of independence and autonomy of the subsystems, that may share some goals, but they may also have opposing goals. Problems found in this example are typical for an Interwoven System.



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