Coherent Architecture Development as a Basis for Technology Development

The subject of this PhD thesis is architecture-centered design. It elaborates especially on two specific areas: the coherence in architectures in a technology development context and the identification of critical development areas via property-based reasoning, based on an understanding of this coherence.

Despite the acceptance and results presented in multiple studies from the application of architectures, the research on architecture work in a technology development context is limited.

Technologies are often developed and represented in the form of product sub-systems that are made available for product developers. Technologies, which in their infancy indicate a 'jack of all trades, master of none', have a risk of being developed without a clearly defined need or identification of which products it can be used in.

A common approach for developing such a technology includes exploration of what the sub-system that carries the technology is, how the sub-system is produced, and how it can be used in new products by means of early prototypes. Developing the prototypes will help identify the needs and requirements to which the technology must prove successful. This coherence between product sub-system, production, and testing in prototypes is essential for identifying the critical areas for development.

This research contributes to the vocabulary and understanding of coherent architecture development in a technology development context, where novel technology is developed.

In order to study coherent architectures in a technology context as a basis for identification of critical development areas, this research has been focused around the following three areas:

1. Product architecture instances for prototypes testing novel technology.
2. Product architecture definition for a sub-system based on a novel technology and the appertaining production architecture needed to realize this sub-system in a given solution space.
3. Coherent architecture as a basis for identification of critical technology development areas.

The two main contributions that are found in this thesis are: The Technology Prototype Product Architecture Tool, developed as part of point number one, and the framework for identification of critical technology building blocks, developed as part of point number three. Additional contributions are found as part of point number two through research on product architectures and production architectures represented through the Conceptual Product Platform tool and the Production Architecture Framework.

The frameworks and tools developed as part of this thesis were developed as part of deep industrial involvement in the Innovation Fund Denmark DEAP project from 2012 to 2015. The results presented in this PhD thesis were gained through active participation in the project.