Designers doing product architecture based development look to convert desired behaviour to solutions for a portfolio of products, and through modularisation pursue commonality among different variants without increasing the internal task proportional to handling variety. To develop product architectures for a portfolio of products that support the right balance between commonality and variety is today a foremost part of most large companies’ development operations. A challenge is that product architectures are influencing external and internal performance of markets, production, technology, organisation, processes, etc. To identify, evaluate, and align aspects of these domains are necessary for developing the optimal layout of product architectures. It is stated in this thesis that architectures describe building principles for products, product families, and product programs, where this project focuses on architecture’s ability to describe product families. Architectures are developed with different objectives in mind, i.e. to obtain a certain effect for a company, such as reducing time-to-market, reducing product cost, increasing R&D efficiency, etc. Visual models with cross functional languages are, in architecture design, seen as key means for supporting designers from different domains and with different backgrounds, in accessing the structures of architectures and their behavioural effects. This PhD project focuses on prescribing how to model structural elements and address behavioural effects in graphical modelling formalisms of architectures. The objective of using the product architecture formalisms is to support designers in identifying, evaluating, and optimising the architecture satisfying the goals of the company in the best way in the view of the resource constraints. This thesis is particularly focusing on one product architecture modelling formalism - The Interface diagram. The formalism has an objective of supporting interdisciplinary designers in developing a product architecture for a product family. However, the large amount of information generated when identifying and developing architectures can be difficult to manage, update, and maintain during development. The concept of representing product architectures in computer-based product information tools has though been central in this research, and in the creation of results. A standard PLM tool (Windchill PDMLink©) is applied for representing a model of a product architecture, and for enabling fast, precise, and safe data transfer, as well as reducing the effort to replicate and modify information. This PhD thesis describes research into the phenomena of developing products based on architectures and how to represent architectures in computer systems. Presented results build on research literature and experiences from industrial partners. Verification of the theory contributions, approaches, models, and tools, have been carried out in industrial projects, with promising results. This thesis describes the means for: (1) Identifying and modelling architectures, (2) Multi-viewpoint modelling for supporting reasoning in converting desired product behaviour (given by requirements and/or functions) into a solution (given by components), (3) Assessing product cost and cost deviations during design, and (4) Assessing completeness of designs during development.