„functions“ in SysML 2.0

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A little excursion in German Engineering History

- Gerhard Pahl / Wolfgang Beitz
  - First published in 1976
VDI 2221:
"Methodology for developing and constructing technical systems and products" (1st edition: 1993)

"functional structure"

"determination of functions and their structures"
VDI 2206:
„Development-methodology for mechatronic systems“
(1st edition: 2004)

“... . The functional integration of mechanical and electrical/electronic components takes place by connecting them by means of material, energy and information flows. The components may in this case be spatially separate from one another. ...:”
V-Modell as the beginning of our thoughts

Interdisciplinary modeling and specification

Interdisciplinary modeling and first simulation

Discipline-specific modeling and simulation

Legend: R, F, L, P: Requirements, functions, logical and physical system elements
What is a function?

- Mathematical function
  \[ f(x) = \frac{a + b}{3} \]

- Software function

- System function

```c
#include <stdio.h>

int add(int a, int b); // function prototype (declaration)

int main()
{
    int num1, num2, sum;
    printf("Enter two numbers to add\n");
    scanf("%d %d", &num1, &num2);
    sum = add(num1, num2); // function call
    printf("Sum = %d", sum);
    return 0;
}

int add(int a, int b) // function declarator
{
    /* Start of function definition */
    int add;
    add = a + b;
    return add; // return statement of function
    /* End of function definition */
}
```
A system function in the Sense of hardware development ...

- ... has inputs and outputs

- ... can be named by a noun-verb combination
e.g. transfer power, calculate delay

- ... is a technology independent description of a system

- ... can be part of a hierarchy and a net

- ... can describes expected behavior
Function as a necessary abstraction layer for interdisciplinary collaboration

- The functional abstraction layer combines the three main engineering disciplines.

Source: Michael Pfenning, XPLM
Scientific work in this area

- Tim Weilkiens and Jesko Lamm: Functional architecture for systems
Scientific work in this area

- PhD-Thesis of Dr.-Ing. Torsten Gilz:
  - PLM-Integrated Interdisciplinary System Models in the Conceptual Design Phase Based on Model-Based Systems Engineering
Scientific work in this area

- Kruse, Shea et al.

A MODEL-BASED FUNCTIONAL MODELING AND LIBRARY APPROACH FOR MECHATRONIC SYSTEMS IN SYSML
Scientific work in this area

- SPES / SPES XT / SPES 2020
**Modeling a function in SysML**

- **Function as a stereotype of „block“**

- **Function as a stereotype of „action“**

- **Function as a stereotype of „activity“**
Summary

- We would like to have the function in the language to ...
  - ... get more acceptance in engineering domains far from software engineering
  - ... support different domains to collaborate with a SysML-based MBSE system model

- We don´t want ...
  - ... the integration of elements of a methodology, like R-F-L-P
Thank you

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