Industry Sector	RTD Thematic Area	Date

Reinventing the wheel

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Summary

There are pros and cons for having a unique solution for a certain class of problems. The cons are the reason why we have to reinvent the wheel so often. How can we gain the best from this non optimal approach.

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What are the benefits of having an all purpose FE Software ?

- DO NOT REINVENT THE WHEEL!
- Buying is nearly always cheaper than development - cause the effort is distributed on many customers
- Higher stability of software code. More customers are using the same software and may exchange know how
- We will have more features available (Complex nonlinear analysis, dynamic, Design, Multiphysics etc)
- With the software we obtain (or believe to obtain) knowledge and possibilities - We might even believe that the responsibility for our work has moved to the author of the software.
- Easy exchange of product data with others.

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What is the problem with the all purpose FE Software ?

- Difficult to use
- Growing Complexity
  - The fractal dimension of a software system is at least greater than 1 i.e. doubling the features will need more than double of effort of the original program
  - The communication effort of a team will increase considerably with it's size. More than 7 people will degrade the overall performance.
  - No one will have an overview of the total system or understand all the manuals and menus
- Growing Inertia
  - Changes will need more time
  - Old features to be kept will hamper developement of new versions
  - Sometimes we need a special solution not yet implemented, this might become to expensive.

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## More problems, not spoken about very often

- MONOPOLY
    - We depend on the good will of the provider of the software
    - The production of add ons to software packets (e.g. AutoCAD) is not easy

- The view of the user:
    - We work on projects and do not want to share our know how with others
    - We will understand some problems only if we have a white box testing facility i.e. learning by doing means programming not clicking

- The view of the other software companies
    - If we earn more money by reinventing the wheel we will do so
    - We want to have the „killing" application which is much more better than those of our competitors.

The interface problem

- We will always have different FE-codes
- We will always have different CAD systems
- We will always have different data exchange formats

- A simple exchange format can be easily implemented but does not transport enough volume of necessary data. So we need manual amendments for any cycle
- A complex format is difficult to implement and might be insufficient either

- What we need is
  - a very simple format or api of a widely used database
  - A rather complex description of possible data
    (as easy as possible but not easier)
  - A simple method to attach our specific data to the global model

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Example for complex interaction

- Dynamic Analysis of a dam
- Thermal stress
- Cracks are opening
- Water is entering the cracks
- Water pressure raising
- Flow forces increase
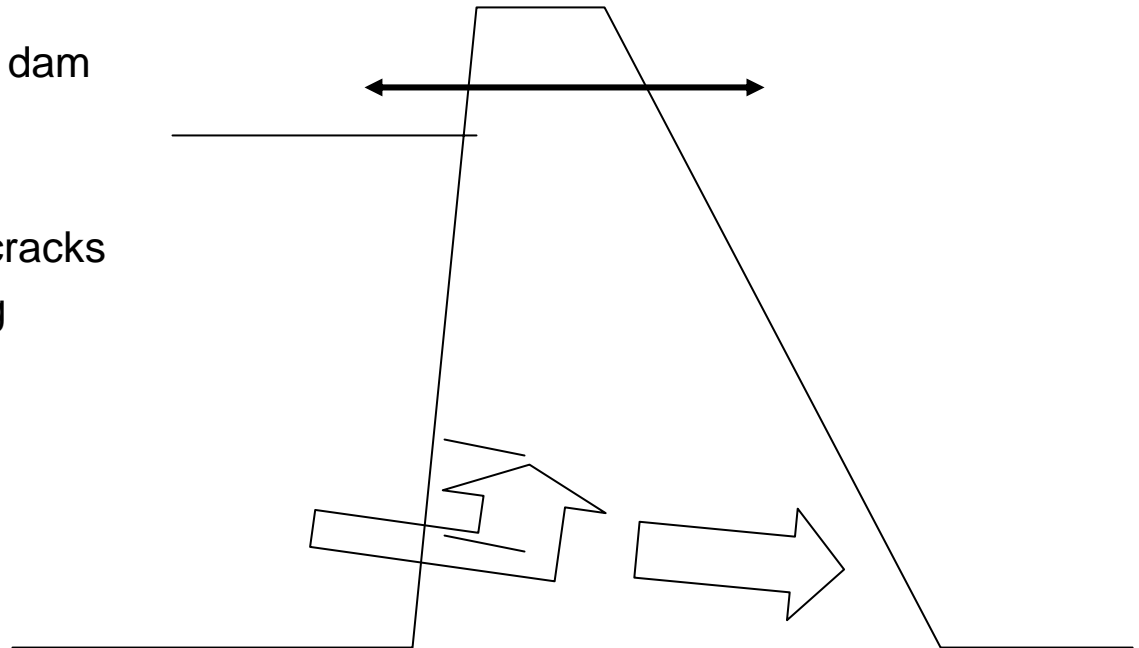
Components of Possible Solutions

- Modularity
  - Separate Tools for separate tasks keep complexity down
  - Clear interfaces facilitate tests and error tracking
  - Interconnectivity via a high speed database
- Object oriented concepts
  - Facilitates the development of components
  - Requires higher organisation effort
  - Is there the invariance of total effort ?
- Macro Languages
  - Provides the user with its own tailored applications
  - Facilitates the reuse of input data

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The Contribution of SOFiSTiK AG:

- Modular program concept
  - = up to 30 different modules (becoming less)
- CDBASE
  - A high speed multi user database containing all data
- BREP of the geometry as an interface to generic CAD-models
  - all information (boundary conditions, properties loading etc) is independent from the FE-mesh
- Full programmable macro Language
  - Two step parser and interpreter
  - Variables, Formulas, Loops, IF-ELSE-ENDIF
  - Access to the database
  - HTML/XML structure of results, allowing editing of data in the report of results and immediate restart of analysis

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