„Process- Family- Points“
-size measurement and effort estimation for process focused software system families-

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Definitions

- **Software- System- Family (SSF)**
  - A SSF “…denotes a set of systems sharing enough common properties to be built from a common set of assets” [Czar+00, p. 31].

- **Process focused Software- System- Family (pSSF)**
  - A pSSF is primarily represented via series of variant rich processes and build from a common set as well as from a supplementary variable collection of reusable software assets.

- **Process- Family- Points (PFP)- Approach**
  - The PFP- Method consists of software metrics to measure the size and estimate the effort for pSSF in the domains of Electronic Business (eBusiness) and Automotive.
Agenda: Process-Family-Points
- **Development project count**: Functionalities after the development of a pSSF and the generation of a product variant.

- **Reuse project count**: Functional size of a product which is generated out of an existing pSSF (pSSF utilization/ pSSF modification).

- **Application count**: Measure of functionality which is attached with the installed product and initialized after the project.
**Demarcation**

- **Application boundary**: Distinction among internal and external functionalities as well as demarcation of the software which then is measured.

- **Counting scope**: Application independent border which can embrace more or less functionality as a single software program.
### 1. Categorization (eBusiness)

<table>
<thead>
<tr>
<th>data functions</th>
<th>asset reuse</th>
<th>locality</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>variable</td>
<td>common</td>
<td></td>
</tr>
<tr>
<td>variable external</td>
<td>X</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>(germ. DVE)</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>variable internal</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>(germ. DVI)</td>
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</tr>
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<td>(germ. DGI)</td>
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</tbody>
</table>

- **Micro Analysis**: Data Categorization
- **Index**: Definitions, Agenda, Type of Count, Demarcation, Micro Analysis, Unadjusted PFP, Macro Analysis, (Quality) Adjusted PFP, Prototypes, References, Discussion
- **Date**: 08 April 2005
- **Authors**: Sebastian Kiebusch & Bogdan Franczyk
2. Complexity Weighting (eBusiness)

- Usage of the general accepted IFPUG FPA method to determine the functional complexity of data assets [cf. IFPU04].

3. Transformation (eBusiness)

- Usage/ extrapolation of IFPUG- FPA conversion factors by:
  \[ y = \frac{1}{6}x^3 - \frac{1}{2}x^2 + \frac{7}{3}x + 3 \]

- Transformation quotients take account of historical experiences (KV/ KG), reuse (IH/ PA), complexity (low/ medium/ high) and locality (external/ internal) of data functions in a pSSF.

- Commonalities:
  \[ \frac{DGE}{DGI} = \frac{\text{unadjusted PFP}_{\text{KG}}}{\text{unadjusted PFP}_{\text{PA}}} \times \frac{\text{conversion factor}_{\text{com}}}{\text{conversion factor}_{\text{var}}} \]

- Variabilities:
  \[ \frac{DVE}{DVI} = \frac{\text{unadjusted PFP}_{\text{KG}}}{\text{unadjusted PFP}_{\text{IH}}} \times \frac{\text{conversion factor}_{\text{com}}}{\text{conversion factor}_{\text{var}}} \]

*KG: correction factors for commonalities; KV: correction factors for variabilities PA: number of generated products; IH: implementation frequency*
### 1. Categorization (Automotive)

<table>
<thead>
<tr>
<th>real time functions</th>
<th>asset reuse</th>
<th>functional validation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>variable</td>
<td>common</td>
</tr>
<tr>
<td>variable soft (germ. EVW)</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>variable hard (germ. EVH)</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>common soft (germ. EGW)</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>common hard (germ. EGH)</td>
<td>-</td>
<td>X</td>
</tr>
</tbody>
</table>
2. Weighting (Automotive)

- The complexity weighting is derived from a real time oriented description of a motor control unit from DaimlerChrysler as an example of an embedded real time pSSF [cf. Rich⁺04].

3. Transformation (Automotive)

- Reutilization of the same conversion factors as used in the data oriented PFP- Micro Analysis.

- Transformation quotients take account of historical experiences (KV/ KG), reuse (IH/ PA), complexity (low/medium/high) and locality (external/internal) of real time functions in a pSSF.

**Commonalities:**

\[
\text{unadjusted PFP}_{\text{EGW} \slash \text{EGH}} = \frac{\text{KV}_{\text{low} \slash \text{medium} \slash \text{high}} \times \text{conversion factor}_{\text{com}}}{\text{PA}}
\]

\[
\text{unadjusted PFP}_{\text{EVW} \slash \text{EVH}} = \frac{\text{KG}_{\text{low} \slash \text{medium} \slash \text{high}} \times \text{conversion factor}_{\text{var}}}{\text{IH}}
\]

**Variabilities:**

- Additional consideration of real time functions which are part of common as well as variable software assets.
### 1. Categorization (eBusiness & Automotive)

<table>
<thead>
<tr>
<th>process functions</th>
<th>asset reuse</th>
<th>locality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>variable</td>
<td>common</td>
</tr>
<tr>
<td>variable internal (germ. PVI)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>variable unidirectional (germ. PVU)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>variable bidirectional (germ. PVB)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>common internal (germ. PGI)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>common unidirectional (germ. PGU)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>common bidirectional (germ. PGB)</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
2. Complexity Weighting (eBusiness & Automotive)
   - **eBusiness**: Derived from a process description of the eBusiness software product Intershop Enfinity [cf. Kieb*05].
   - **Automotive**: Derived from a process description of a motor control unit from DaimlerChrysler [cf. Rich*04].

3. Transformation (eBusiness & Automotive)
   - Usage/ interpolation of the data & real time- conversion factors
   - Transformation quotients take account of historical experiences (KV/ KG), reuse (IH/ PA), complexity (low/ medium/ high) and locality (external/ internal) of process functions in a pSSF.
     - **Commonalities**:\[
     \text{PGI} / \text{PGU} / \text{PGB} = \frac{\text{KG}_{\text{low/ medium/ high}}}{\text{PA}} \times \text{conversion factor}_{\text{com}}
     \]
     - **Variabilities**:\[
     \text{PVI} / \text{PVU} / \text{PVB} = \frac{\text{KV}_{\text{low/ medium/ high}}}{\text{IH}} \times \text{conversion factor}_{\text{var}}
     \]
   - Additional consideration of process functions which are part of common as well as variable software assets.
**Unadjusted Process-Family-Points**

**eBusiness-size measurement:**
- Unadjusted PFP composed of a data as well as of a process view

**Automotive-size measurement:**
- Unadjusted PFP consisting of a real time and process perspective

Unadjusted PFP are comparable to:
- IFPUG Unadjusted Function Points
- COSMIC Functional Size Unit
- UKSMA MKII Function Point Index
- Unadjusted Object Points
- Unadjusted Data Points
Macro Analysis: Domain Independent (Mandatory)

<table>
<thead>
<tr>
<th>ID</th>
<th>documentation</th>
<th>value</th>
<th>effect on effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 01</td>
<td>Is it necessary to create technical and/or functional specifications?</td>
<td>yes</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
<td>decrease</td>
</tr>
<tr>
<td>A 02</td>
<td>Is it a must to documentate the usage of software metrics?</td>
<td>yes</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
<td>decrease</td>
</tr>
<tr>
<td>A 03</td>
<td>Is it planned to write a documentation about the code?</td>
<td>yes</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
<td>decrease</td>
</tr>
<tr>
<td>A 04</td>
<td>Is it a must to develop a user guide?</td>
<td>yes</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
<td>decrease</td>
</tr>
<tr>
<td>A 05</td>
<td>Is it planned to create a defect documentation and/or a test paper?</td>
<td>yes</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no</td>
<td>decrease</td>
</tr>
</tbody>
</table>

numeral influence
number of increasing values
Macro Analysis: Domain Dependent (Mandatory)

- eBusiness influencing factors (domain dependent)
  - flexibility
    - user administration
    - scalability
    - availability
    - migration
    - connectivity
  - marketing
    - product
    - price
    - promotion
    - place
    - market research
  - legal position
    - contract law
    - consumer protection
    - copyright
    - branding
    - data protection & security

- Automotive influencing factors (domain dependent)
  - computing power
    - generation of language
    - parallelization
    - design & algorithms
    - access times
    - data layout
  - safety
    - monitoring
    - FMEA- analysis
    - FTA- analysis
    - vehicular subsystem redundancy
  - memory volume
    - estimation tools
    - characteristic diagrams
    - priority approach
    - virtual memory
    - caching
Macro Analysis: Quality Dependent (Optional)

- **Functionality**
  - Suitability, accuracy, interoperability, security, functionality, compliance
- **Reliability**
  - Maturity, fault tolerance, recoverability, reliability, compliance
- **Usability**
  - Understandability, learnability, operability, attractiveness, usability, compliance
- **Efficiency**
  - Time behaviour, resource utilization, efficiency, compliance
- **Maintainability**
  - Analysability, changeability, stability, testability, maintainability, compliance
- **Portability**
  - Adaptability, installability, co-existence, replaceability, portability, compliance

### Efficiency and Value

<table>
<thead>
<tr>
<th>ID</th>
<th>Efficiency</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D15</td>
<td><strong>time behaviour</strong>: What’s the effort scale of providing appropriate response and processing times and throughput rates when performing software functions under stated conditions?</td>
<td>low</td>
</tr>
<tr>
<td>D16</td>
<td><strong>resource utilization</strong>: What’s the effort scale of using appropriate amounts and types of resources when the software performs its functions under stated conditions?</td>
<td>average</td>
</tr>
<tr>
<td>D17</td>
<td><strong>efficiency compliance</strong>: What’s the effort scale of adhering to standards or conventions relating to efficiency?</td>
<td>high</td>
</tr>
</tbody>
</table>

### Numerical Influence

\[
\text{numeral influence} = \left( \frac{\text{number of high values}}{3} - \frac{\text{number of low values}}{3} \right)
\]
**PFP Macro Analysis:**
- Flexible modification and extension of influencing factors
- Versatile applicability
- Potential substitution of IFPUG or UKSMA adjustment procedures

**Adjusted PFP are comparable to:**
- IFPUG Adjusted Function Points
- UKSMA MKII Adjusted Function Point Index

**Quality adjusted PFP are akin to:**
- Adjusted Object Points
- Adjusted Data Points
Adjusted PFP:

- Justification of max. +/- 35%
- 20 domain independent, 15 eBusiness or 15 Automotive factors.

Quality adjusted PFP:

- Justification of max. +/- 50%
- 27 quality factors according to [ISO01], 20 domain independent, 15 eBusiness or 15 Automotive factors.
References


Further Reading


Genuine thanks for your attention!

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