The Generalized Reuse Framework: Strategies and Decision Process for Planned Reuse

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Outline

- Basic concept

- Process definition and use cases

- Cost estimating relationship

Found Bobby…

Approaches to Reuse

Unplanned / Opportunistic Reuse:

- Search & discover
- Modify & adapt
- Fix problems

- Case-by-case, ad hoc tailoring
- Individual knowledge
- Best for low-level, smaller scale components

"Samurai's Effort"

Planned / Strategic Reuse:

- Product strategy & roadmap
- Planning & coordination
- Investment decisions

- One-to-many, tailoring by design
- Corporate knowledge
- Best for large scale, product line, lifecycle reuse

"Team Sport"

"Generalized Reuse Framework" – Planned / Strategic Reuse

Development For Reuse (DFR)
- Development activities that produces <u>reusable artifacts</u> for future usage
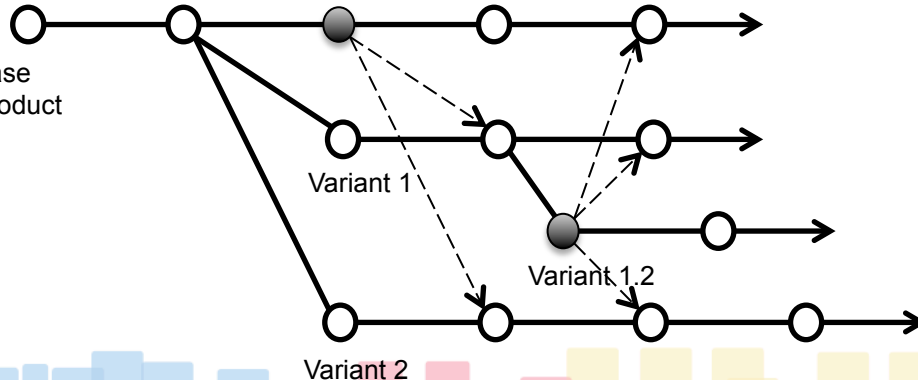- Focus on strategic planning and investment for future benefits

Development With Reuse (DWR)
- Development activities leveraging <u>reusable artifacts</u>
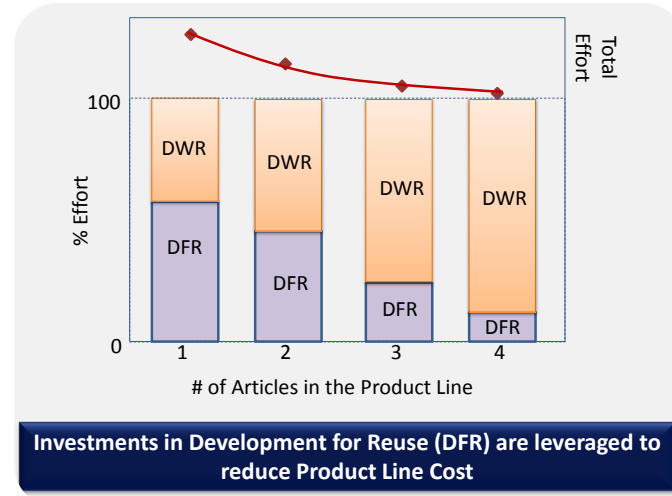- Focus on cycle time reduction and cost savings

Base Product

Variant 1

Variant 1.2

Variant 2

Key phrase is...
- "**Strategic Planning**"

Reuse in a Project – a Lifecycle Perspective

Project Work Scope =   DWR Content +   DFR Content

As the number of articles increases, the relative DFR decreases while relative DWR increases…

Investments in Development for Reuse (DFR) are leveraged to reduce Product Line Cost

What Do We Actually Reuse?

- Reuse…
  - System?
  - Component?
  - Software code?

- Two views of "**System**":
  - Component view: "*pieces and parts*"
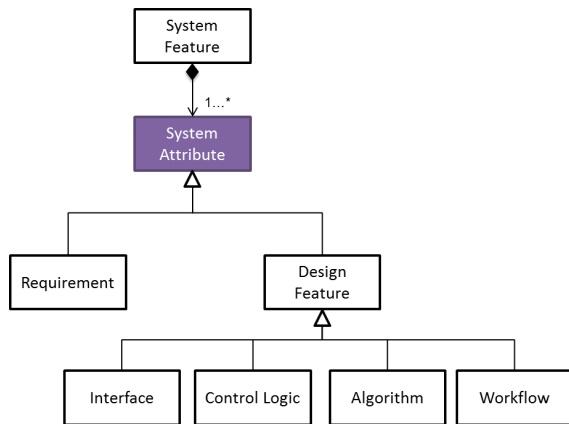 - Functional view: "*functions and features*"

A Reuse Taxonomy

Functional System made of "**Bill of Features**":

Realized by "**System Artifacts**" developed:

… **We reuse "system attributes" through a unique combination of "system artifacts"**
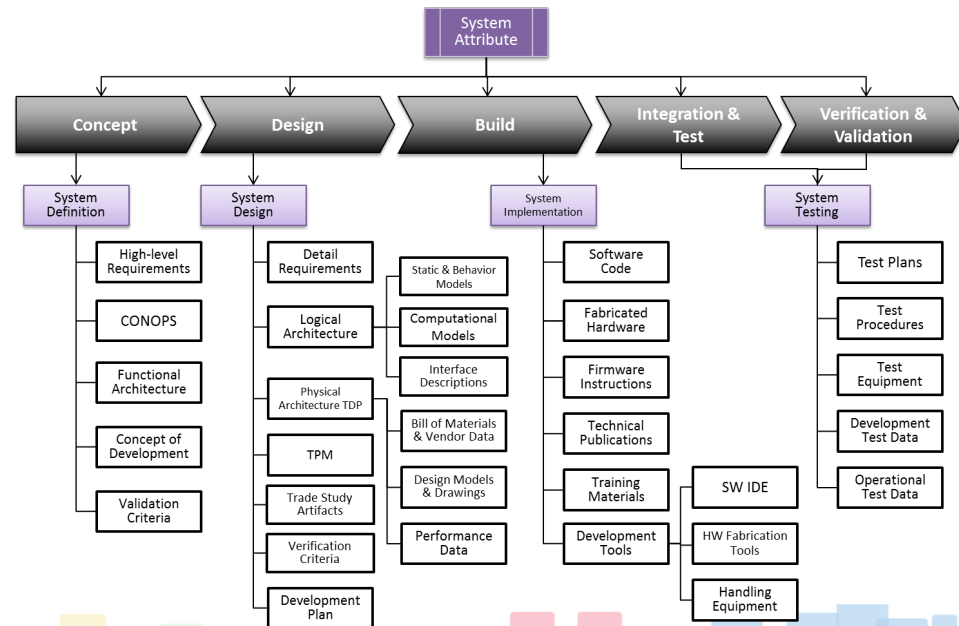
Generalized Reuse Framework Defines Two Interactive Processes

Development for Reuse (DFR):

- *No DFR*
- *Conceptualized For Reuse*
- *Designed For Reuse*
- *Constructed For Reuse*
- *Validated For Reuse*

Development with Reuse (DWR):

- *New*
- *Design Modified*
- *Design Implemented*
- *Adapted for Integration*
- *Adopted for Integration*
- *Managed*

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Development for Reuse (DFR) Process

| Category	Required Activities	Delivering (for reuse)
No DFR	• N/A	• Little / accidental
Conceptualized For Reuse	• Analysis • Architecture development	• Functional & Logical architecture
Designed For Reuse	• Analysis • Architecture • System design	• Physical design of system
Constructed For Reuse	• Design • Build • Unit test	• Implemented system or component
Validated For Reuse	• Design • Build • System test	• Validated and deployed system or component
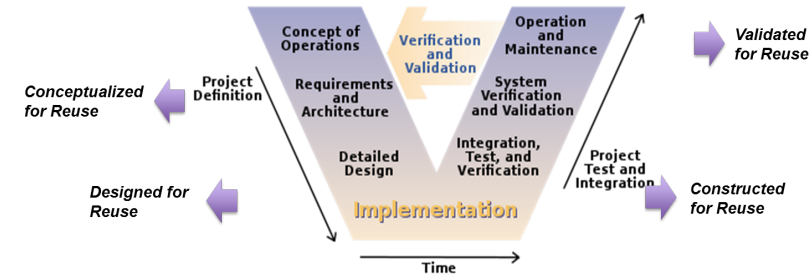
Activity-based Model

Development with Reuse (DWR) Process

Category	Required Activities	Leveraging (existing)
New	• Develop anew • Revamp of existing	• New concept
Design Modified	• Design & implement from logical architecture	• Logical/functional architecture
Design Implemented	• Implement from design • Build-to-print	• Physical design of system
Adapted for Integration	• Adapt from existing implementation • Tailor to integrate	• Built system or component
Adopted for Integration	• Integrate per instructions • V&V testing	• Build system or component
Managed	• Manage • Inspect	• Integrated & verified system or component

Activity-based Model
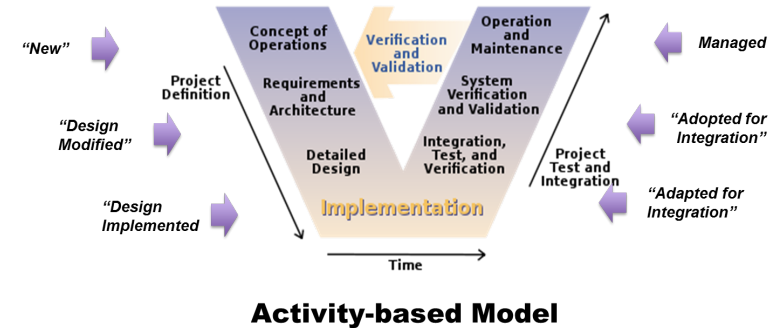
Managing Reuse: Interactions between DWF & DFR Processes
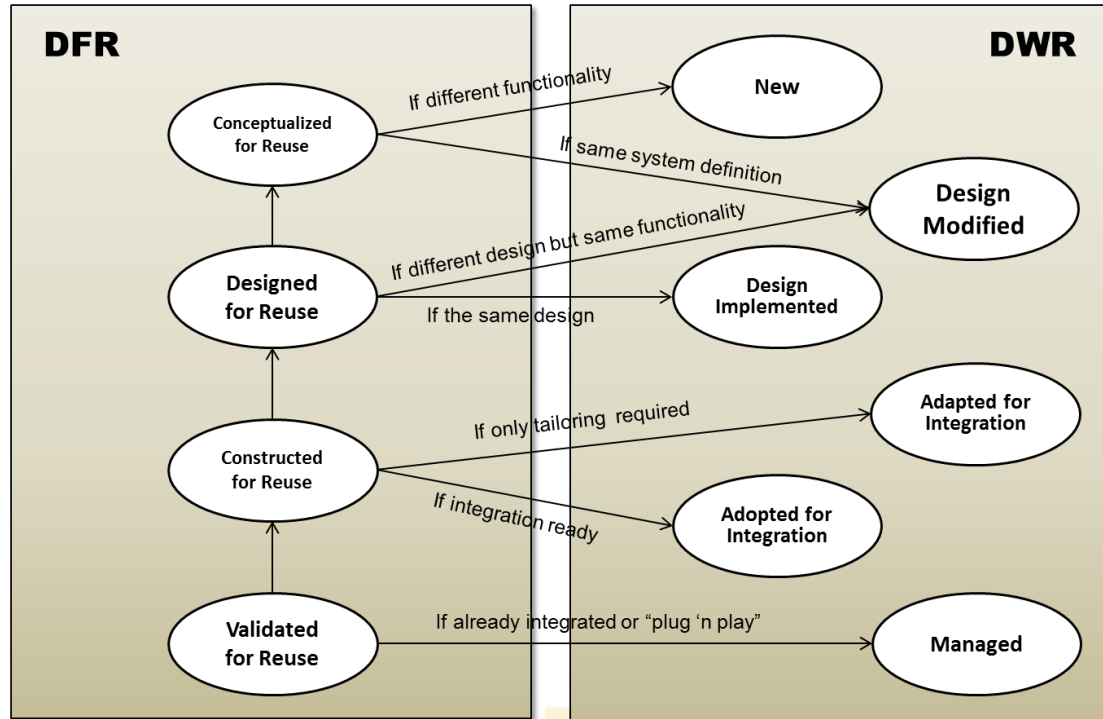
COSYSMO 1.0 – Original Model Form

No Reuse Consideration

$$PM_{NS} = A \cdot \left(\sum_k (w_{e,k}\Phi_{e,k} + w_{n,k}\Phi_{n,k} + w_{d,k}\Phi_{d,k}) \right)^E \cdot \prod_{j=1}^{14} EM_j$$

Where

PM_{NS} = effort in Person Months (Nominal Schedule)

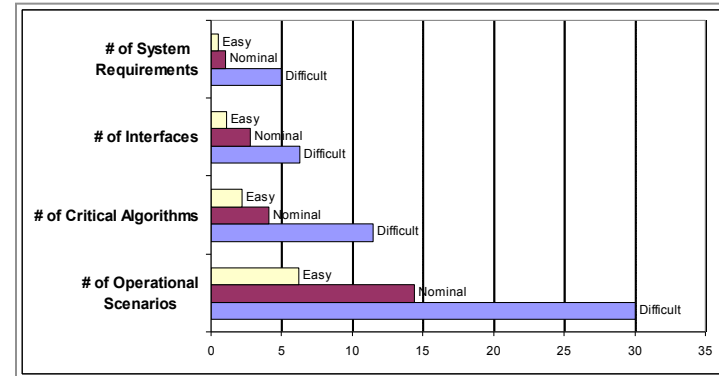A = calibration constant derived from historical project data

k = {**REQ, IF, ALG, SCN**}

w_x = weight for "easy", "nominal", or "difficult" size driver

Φ_x = quantity of "k" size driver

E = represents (dis)economies of scale

EM_j = effort multiplier for the jth cost driver; the geometric product results in an overall effort adjustment factor to the nominal effort.

COSYSMO 2.0 – a DWR Model

Partial Reuse Consideration

Total Project Effort = DWR Effort

$$ PM_{DWR} = A \cdot \left[\sum_k \left(\sum_r w_r (w_{e,k}\Phi_{e,k} + w_{n,k}\Phi_{n,k} + w_{d,k}\Phi_{d,k}) \right) \right]^E \cdot CEM $$

Where:

PM_{DWR} = effort in Person Hours/Months (Nominal Schedule)

A_1 = DWR constant derived from historical project data

k = {REQ, IF, ALG, SCN}

r = {*New, Modified, Deleted, Adopted, Managed, Designed for Reuse*}

w_r = weight for defined levels of size driver reuse

w_x = weight for "easy", "nominal", or "difficult" size driver

Φ_x = quantity of "k" size driver

E_1 = represents diseconomy of scale in DWR

CEM_1 = composite effort multiplier for DWR

Reuse Categories:
- *New*
- *Modified*
- *Deleted*
- *Adopted*
- *Managed*
- *Designed for Reuse*

COSYSMO 3.0 – Generalized Reuse Framework

Full Reuse
Consideration

Total Project Effort = DWR Effort + DFR Effort

$$PM_{DWR+DFR} = A_1 \cdot \left[\sum_k \left(\sum_r w_r (w_{e,k} \Phi_{e,k} + w_{n,k} \Phi_{n,k} + w_{d,k} \Phi_{d,k}) \right) \right]^{E_1} \cdot CEM_1$$

$$+ A_2 \cdot \left[\sum_k \left(\sum_q w_q (w_{e,k} \Psi_{e,k} + w_{n,k} \Psi_{n,k} + w_{d,k} \Psi_{d,k}) \right) \right]^{E_2} \cdot CEM_2$$

Where:

PM_{DWR} = effort in Person Hours/Months (Nominal Schedule)
A_1 = DWR constant derived from historical project data
k = {REQ, IF, ALG, SCN}
r = {*New, D. Modified, D. Implemented, Adapted for Int., Adopted for Int., Managed*}
w_r = weight for defined levels of size driver reuse
w_x = weight for "easy", "nominal", or "difficult" size driver
Φ_x = quantity of "k" size driver
E_1 = represents diseconomy of scale in DWR
CEM_1= composite effort multiplier for DWR

Where:

PM_{DFR} = effort in Person Hours/Months (Nominal Schedule)
A_2 = DFR constant derived from historical project data
k = {REQ, IF, ALG, SCN}
q = {*No DFR, Conceptualized, Designed, Constructed, Validated*}
w_q = weight for defined levels of size driver reuse
w_x = weight for "easy", "nominal", or "difficult" size driver
Φ_x = quantity of "k" size driver
E_2 = represents diseconomy of scale in DFR
CEM_2 = composite effort multiplier for DFR

Conclusion

- *Generalized Reuse Framework (DFR & DWR)*:

  – Provides a strategic reuse planning framework

  – Enables product line and technology roadmap planning

  – Parametric model (COSYSMO) provides

    • Cost and budgetary insights

    • What-if analysis for product-line investment decisions

Thank You

Questions or Comments