The Uses of the Peer Review beyond CMMI®

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Research Question

- CMMI ® uses the peer review to identify and record product defects at different design phases
- Author observed that in early design phases this paradigm does not seem to fully capture what takes place in peer reviews
- What, then, are the uses of the peer review beyond its role in CMMI ®?

Method

- Inductive (mostly)
- Observational techniques (ethnographic)
  - Actual discussions/activities during the peer review
- Analysis of peer review artifacts
  - Formal peer review comments and resolutions
  - Analysis of smaller sample to develop categories/codes
  - "Coding" of formal comments for multiple peer reviews across product levels and phases
  - Compile descriptive statistics
    - Proportions of categories for all peer reviews
    - Comparison of categories across product levels/phases
- Draw conclusions – peer reviews in general, CMMI® in particular

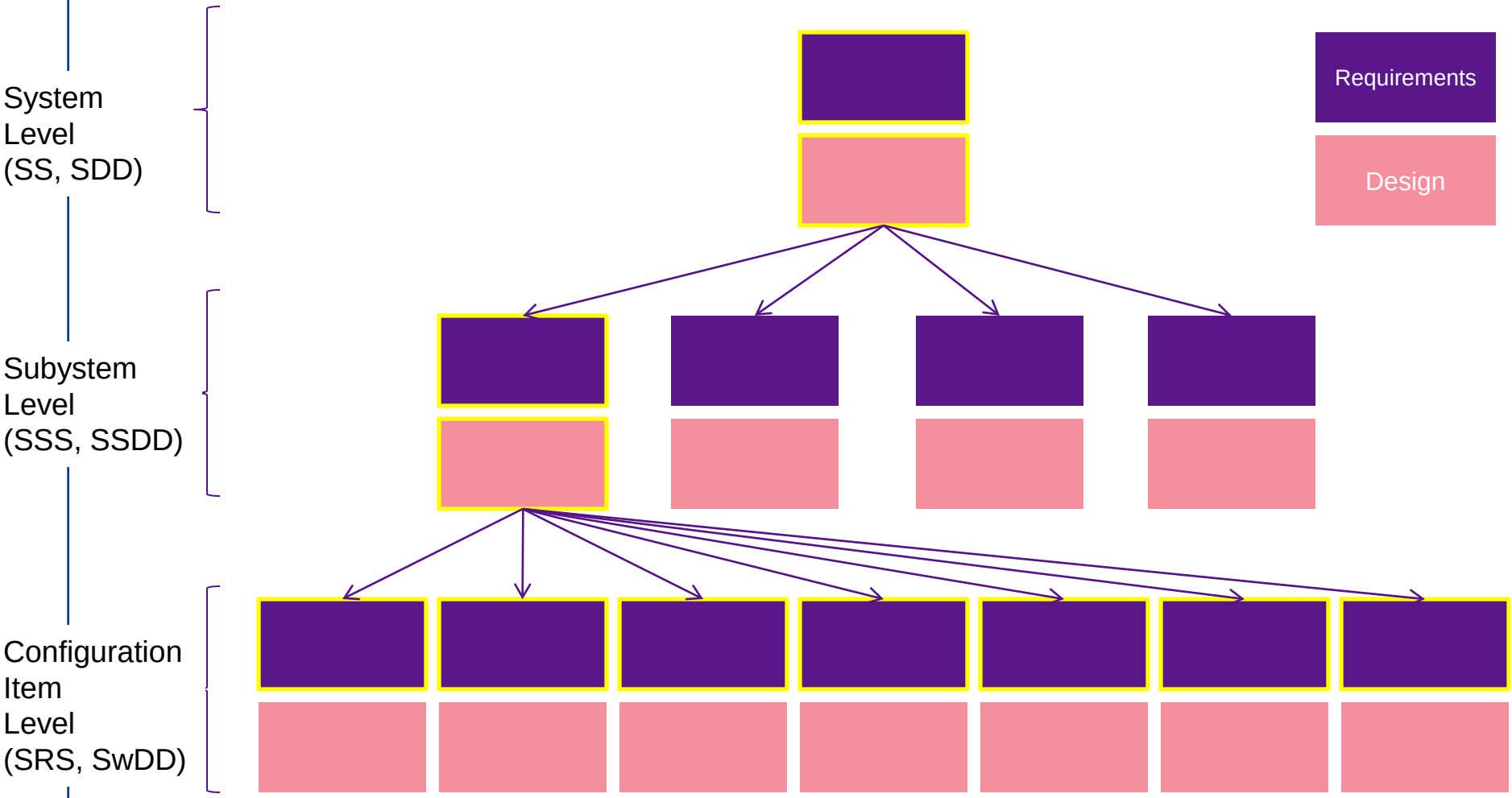
Method - Coding Categories

- Documentation/Process
  - A change that results from deficiencies in the documentation itself or failure to adhere to documented process AND does not influence the design of the end-product
  - Example: *"this section needs to be scrubbed to be in conformance with DRB requirements (OD's/WS's in different subsections, ICD volume called out, etc.)"*
- Question
  - A comment that is a question that is answered and does not result in any change to the document
  - Example:
    - Comment: *"Is the 'Deployment Test Common test support software' supposed to be in FRTA?"*
    - Response: *"No, this is common software strictly in the OCS (not the EGISS portion)."*
- Product Defect:
  - A deficiency in the product given the collective baseline understanding of the desired product
  - Example:
    - Comment: *"You need a requirement to check if the system is in the Operate Power state for this test."*
    - Response: *"I added 'operate power state' to the check in the subsequent requirement. Deleted this object."*
- Product Enhancement
  - Not a deficiency to the collective baseline, but rather a recommendation for making the product better
  - Example:
    - Comment: *"The IOSS takes the RFT SWM DIAG DATA from all subsystems and nodes and "or"s it to create an overall RFT status which is sent to MSS in the GS data for MSS message. You might want software to check that first and then get all the RFT messages as part of the diagnostics."*
    - Response: *"changed req't to a generic req't which adds the IOSS GS data for MSS msg to check for an RFT failure."*

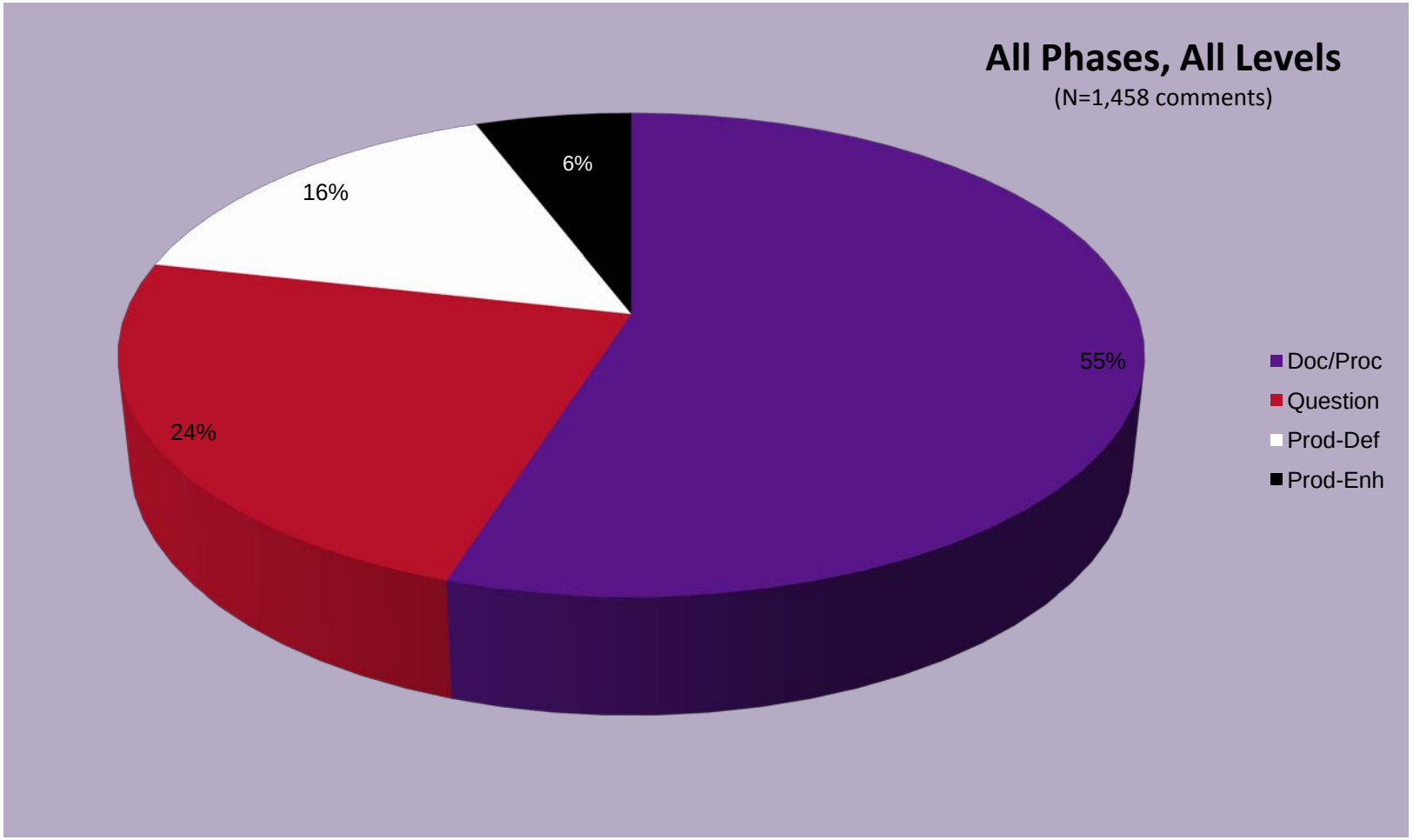
Method - data

- Peer review artifacts data set
  - System test program
    - Suite of tests developed to execute within the system and the host test equipment
  - 20 peer reviews - 1,458 comments
    - 15 from configuration item level products (Software Requirements Specifications)
      - Two phases
        - initial version
        - substantial update (formal delivery)
    - 5 from higher level (system, sub-system) specifications
    - Prior to initial document, Power-Point presentation of design concept used establish consensus on feasibility and adequacy of design

Method – product types



Descriptive Statistics



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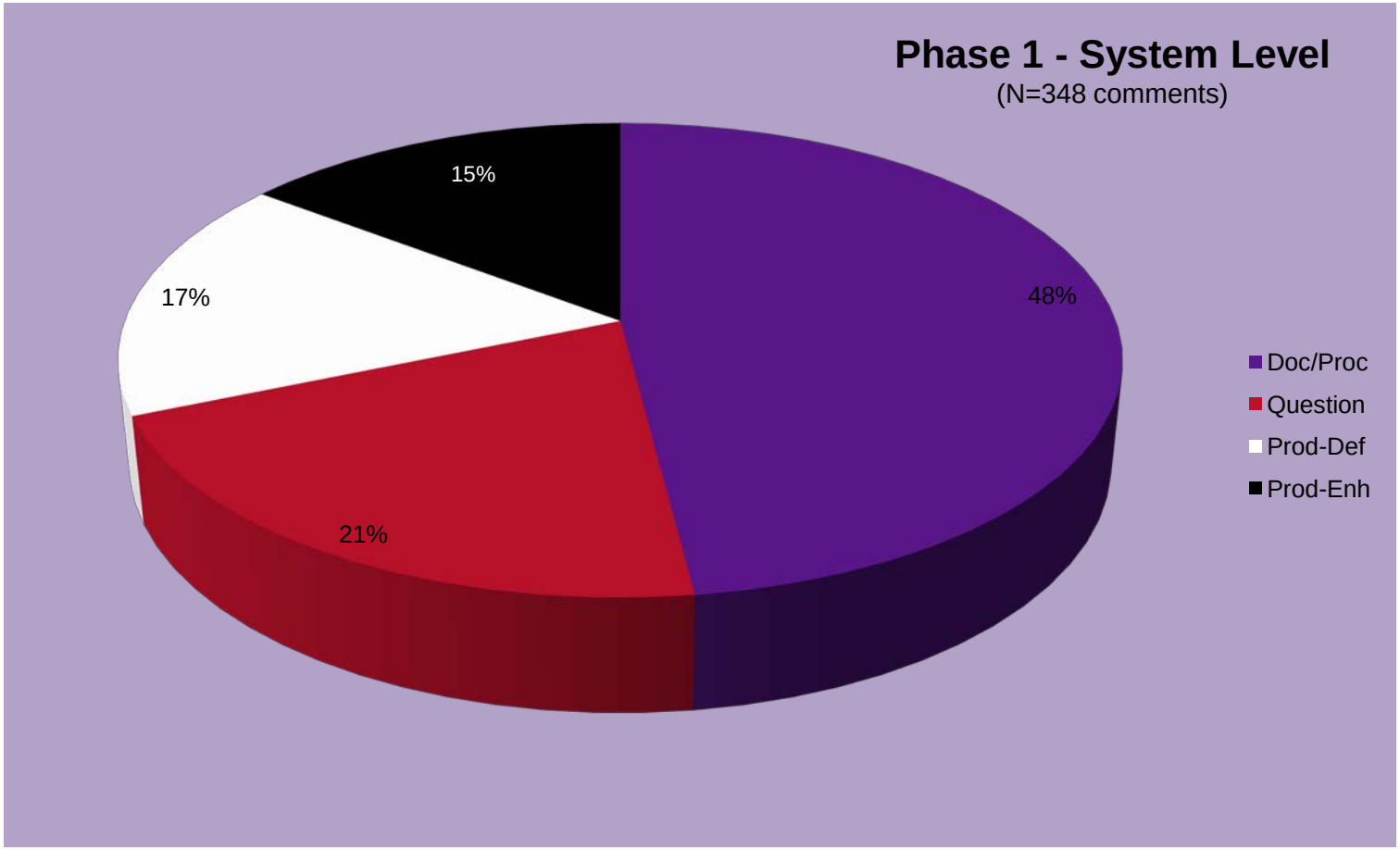

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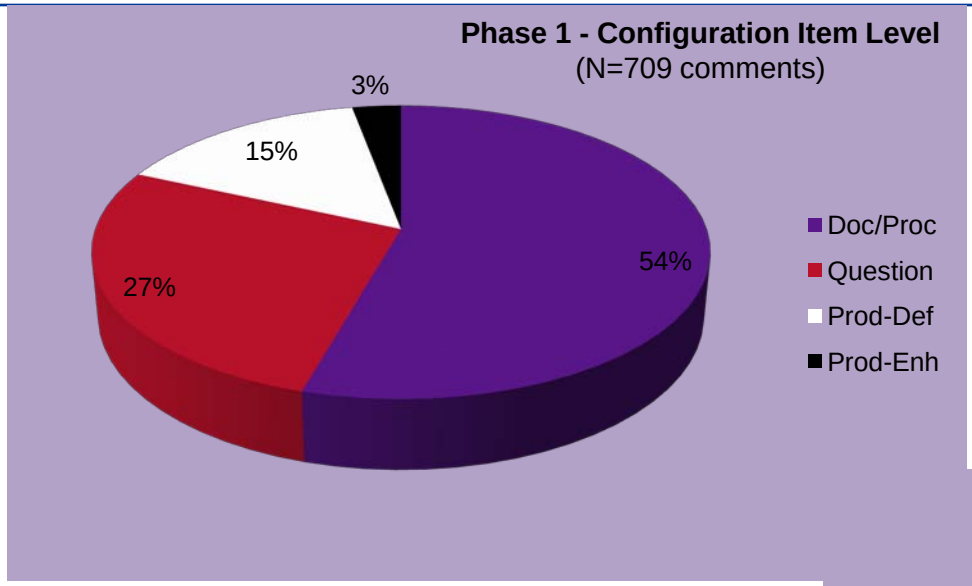

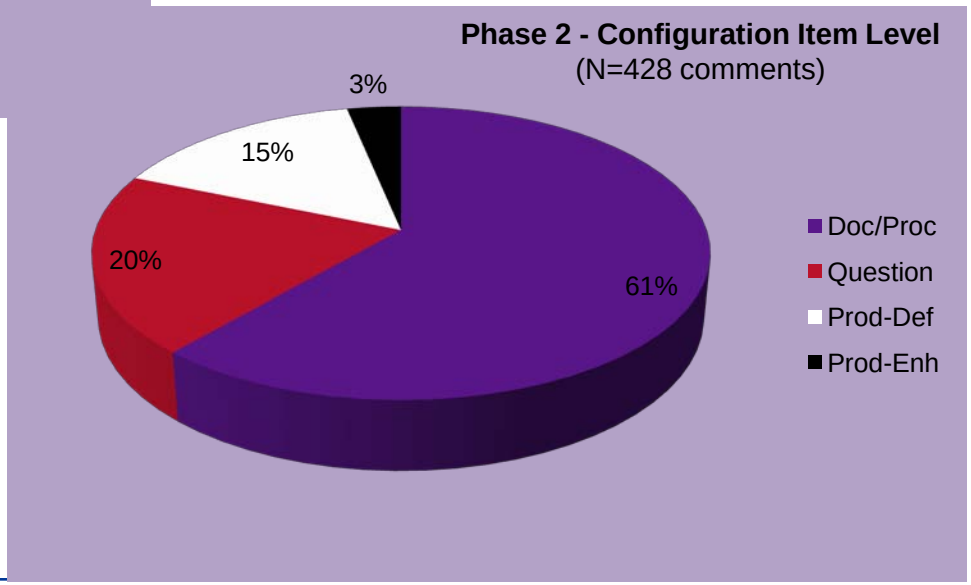

Ethnographic Observations

- Commentary not directly related to peer review comments
  - Scheduling/logistics of the meeting
  - Priorities (actual versus planned program needs)
  - Readiness of product relative to program expectations
  - Commentary about the program in general and issues of commonality, consistency, and restructuring
  - Humor – novel combinations of meanings, parallels, inconsistencies, process requirements (some cynicism)

Peer review is a meeting of peers and stakeholders and is therefore a social resource (communications, self-presentation, learning, etc.)

Conclusions

"Designing Products" versus "Producing Designs"

Designing activity

- assumption that product not yet fully conceived/designed
  - need for expert/stakeholder input
  - bounded rationality, brainstorming, creativity, innovation
  - endemic to the engineering design process
- metric = opportunities, creations, trades, problem resolution
- goal is to create something that meets expectations
- more prevalent in top of product hierarchy and in early phases
- product = satisfactory requirements, architecture, design

Validating activity

- assumption that design activity is complete (design "should be" perfect)
- goal is to find defects and optimize process (CMMI®)
- product = codification of design (req.s, architecture, documentation
  conformance to process/standards)

Conclusions
Process Improvement Thoughts

- Strive for more design maturity prior to peer review
  - Scheduling - sufficient margin for design activity
  - Concept reviews, pre-reviews - all stakeholders, multiple iterations, accountability
- Recording artifacts
  - Baselining – freeze design so that peer review defects pertain to specific agreed-to design (e.g., a peer review associated with a previously “blessed” concept package)
  - Peer review comments categorized as informal – against next baseline
- Reward good design activity/innovation
  - Recommend creating new CMMI® category called “enhancement” that does not get included in defect rates, can be tracked independently
  - Provides insight into the relative proportions of design versus validation activity taking place in peer reviews

- Background Materials

The Peer Review in the CMMI Context

BACK

- "Peer reviews involve a methodical examination of work products by the producers' peers to identify defects and other changes that are needed." CMMI® (v 1.2, p. 497)
- Examples of peer review data that can be analyzed include the following:
  - • Phase defect was injected
  - • Preparation time or rate versus expected time or rate
  - • Number of defects versus number expected
  - • Types of defects detected
  - • Causes of defects
  - • Defect resolution impact
- Analysis focused on process corrective action

Engineering Design Process

BACK

- **Braha, D. and Maimon, O. (1997). "The Design Process: Properties, Paradigms, and Structure." IEEE Transactions on Systems, Man, and Cybernetics – Part A: Systems and Humans, Vol. 27, NO. 2, March 1997.**
  - "Decision-making during the design activity deals with highly complex situations. The traditional methods of decision-making are based on the classical model of pure rationality, which assumes full and exact knowledge about the decision situation being considered. In design, assumptions about the exact knowledge are almost never true…. The departure from 'pure-rationality' based methods is needed in design because of the fact that the designer has limited information-processing capability and the information is vague. Generally, designers act and behave under conditions of 'bounded-rationality'." [p. 148]
  - Design Process Categories [p. 151]:

Design Activity

- Creative – "domain specific knowledge that is needed to generate the solution set and the set of explicit constraints (such as functionality, performance, environmental, manufacturability, and resource constraints) may be partially specified, while the set of possible solutions, the set of transformation operators, and the artifact space are unknown.
- Innovative – "the decomposition of the problem is known, but the alternatives for each of its subparts do not exist and must be synthesized. Design might be an original or unique combination of existing components."
- Redesign – "the act of successive changes or improvements to a previously implemented design. An existing design is modified to meet the required changes in the original requirements."

Verification Activity

- Routine – "the artifact's form, its method of design, and its mode of manufacture are known before the design process actually begins. It follows that an *a priori* plan of the solution exists and that the general nature of the requirements (satisfied by the design) is also *a priorily* known."