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Set-Based Prototyping

Ashwin Michaelraj
Graduate Research Assistant
Mechanical Engineering Department
Clemson University
amichae@clemson.edu

Dr. Joshua D. Summers
Assistant Professor
Mechanical Engineering Department
Clemson University
joshua.summers@ces.clemson.edu



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- Prototype
 - Definition
 - Conventional Prototyping practice
 - Advantages & Limitations
- Introduction to Set-Based Prototyping
 - Working principle / ‘Set-Based’ principle
 - Need for ‘Set-Based Prototyping’
 - Intended use
- Requirements for a SBP Tool
 - Identifying factors and characteristics that influence prototype selection
 - Prototype design space
 - SBP tool architecture
- Experiments to validate SBP Tool
 - Student project trials
 - Web trials
- Thesis time line
 - Work completed
 - Future work

- Definition

- A prototype is a physical instantiation of a product, meant to be used to help resolve one or more issues during the product development [1, 2]
- Other definitions include
 - Test-beds which enable designers to test their design [3]
 - An artifact or model (physical or virtual) which acts as a catalyst for further development and evolution [1]



Physical Prototype

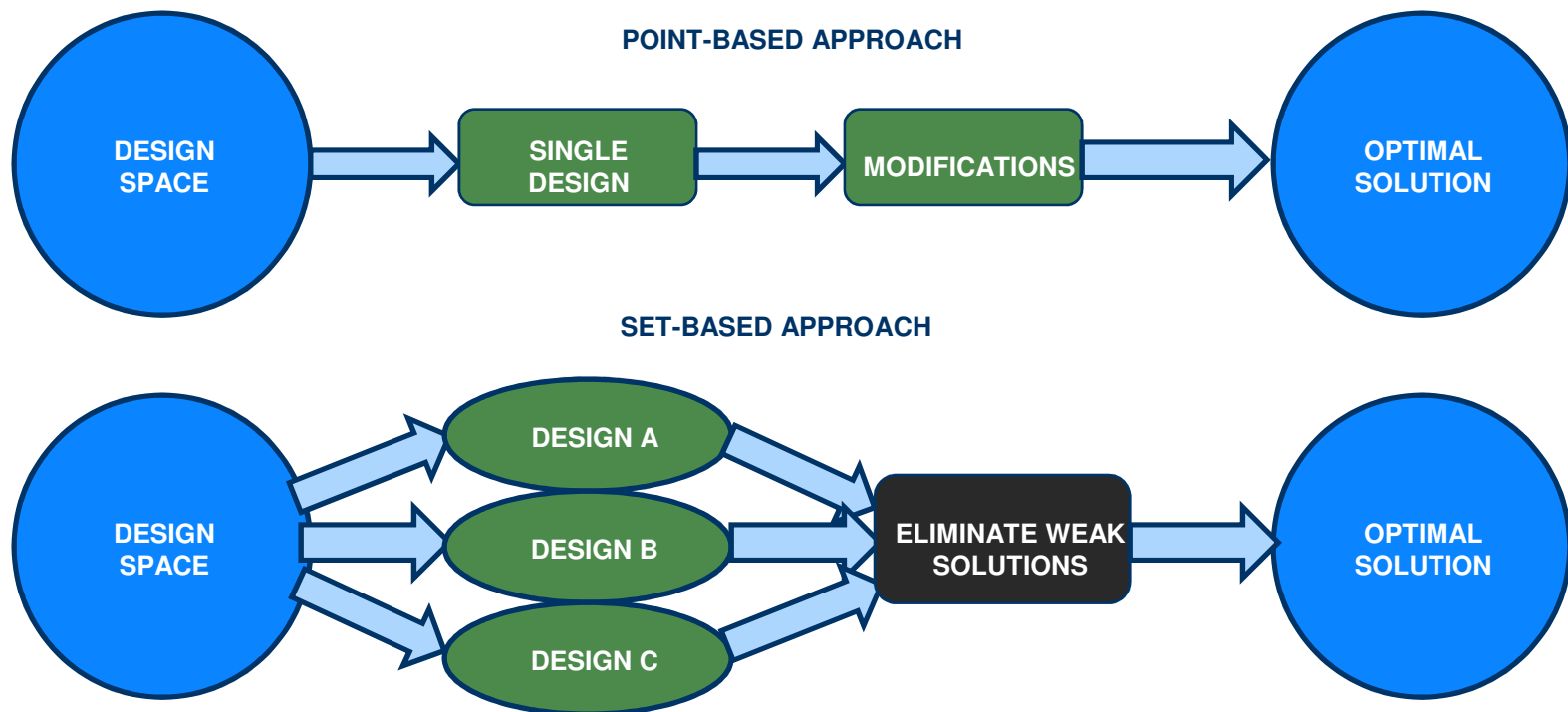


Virtual Prototype

- Advantages
 - Physical prototypes help detect unanticipated phenomena
 - Reduces the chances of failure of a product
 - May expedite other product development processes
- Limitations
 - General
 - Physical prototypes are time consuming* when compared to virtual/analytical prototype
 - Flexibility offered by virtual/analytical prototypes in modifying design parameters is higher than the physical prototypes
 - Selection (Currently prototypes & prototyping techniques are selected based on intuition or experiential knowledge)
 - When to prototype during a design process?
 - Which prototype suits designer's needs?

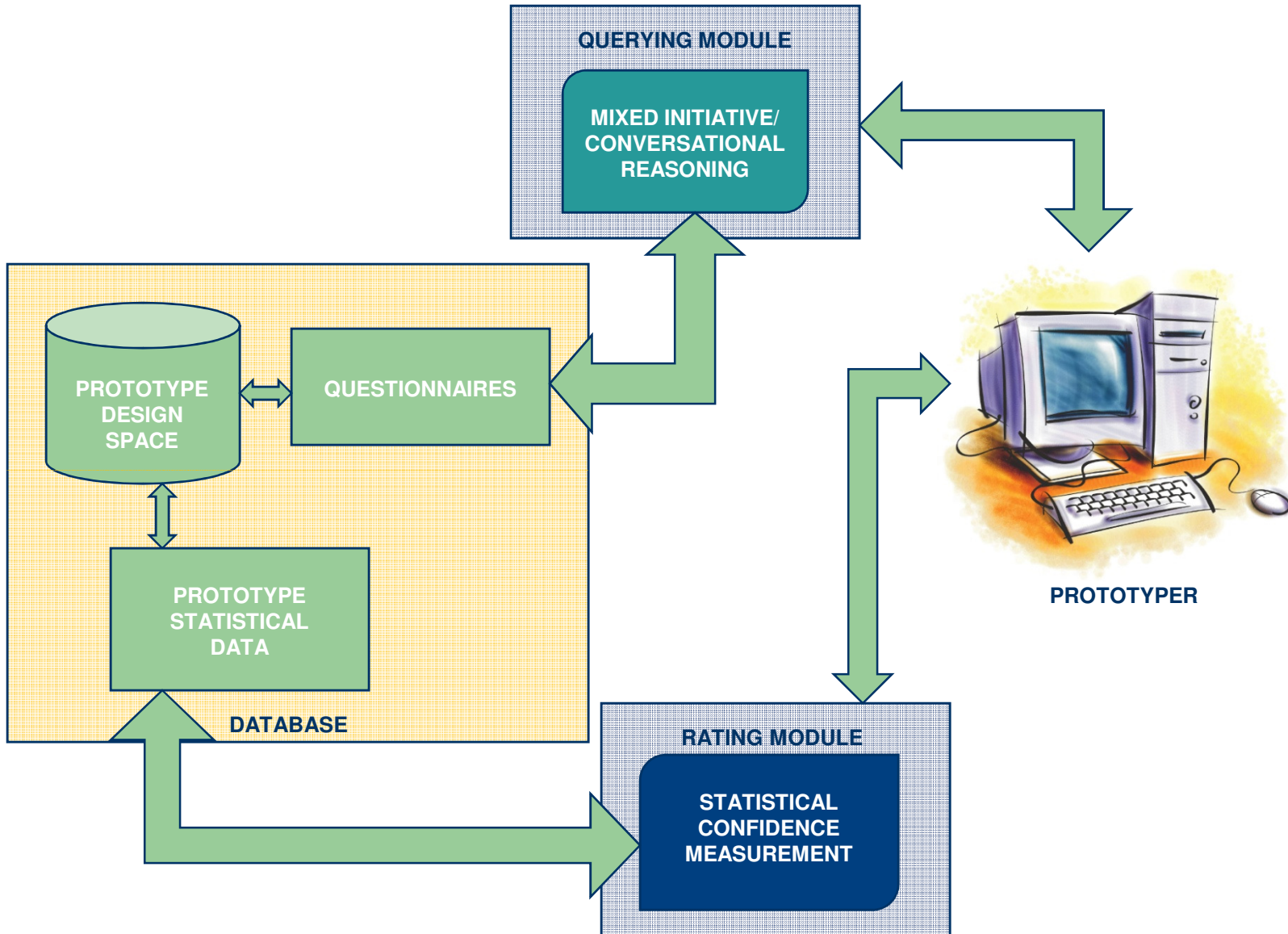
* (depends on complexity of design)

- 'Set-based' principle
 - Invented by Toyota Motor Corporation as a part of lean product design technique known as Set-Based Concurrent Engineering (SBCE)
 - Begins by considering 'sets of possible solutions' and then narrowing down the solutions by eliminating the weaker solutions [5]
 - Deductive approach (Set-based) rather than Inductive approach (Point-based)

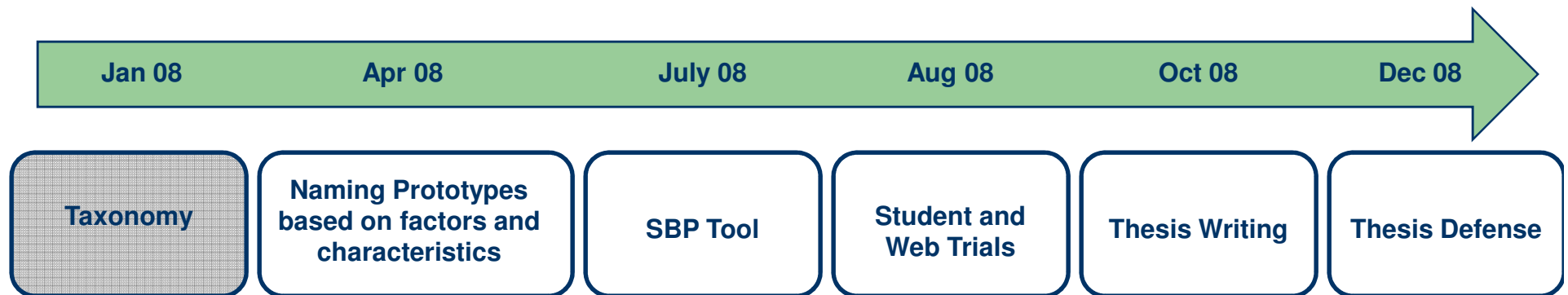


- Set-based prototyping approach offers following advantages over traditional point-based prototyping approach
 - Rate of convergence of a final solution is higher
 - Reduces the probability of starting all over again
 - Eliminates the need for multiple iteration of a prototype
 - Quality of solution obtained is higher
 - Though populating sets of solution from design space seems time consuming, in general it leads to reduction in overall product development cycle [5]
- Intended use of set-based principle
 - Selection of prototypes during product development (which is currently based on intuition/experiential knowledge)
 - Develop a design tool which helps even a novice designer with a structured approach to prototype selection

- Identifying factors and characteristics that influence prototype selection
 - Communication
 - Evaluation purpose
 - Cost
 - Design stage
 - Size
 - Type (Novel, Variant)
 - Material
 - Fabrication
- Prototype design space
 - Classifying and naming prototypes based on these factors and characteristics (Taxonomy)
- Querying system to extract information about the desired prototype from designer
 - Based on Mixed initiative/Conversational reasoning techniques
- Confidence rating system
 - A statistical ranking system to identify which prototype serves the intended purpose(s) better
 - Say Prototype A – 75% Confidence level, Prototype B – 90% Confidence level etc



- Student project trials
 - ME 402 – Design projects – Fall 08
- Web Trial
 - Based on the feed back from student projects an online version of the tool will be made available to designers and academia
- Thesis time line



1. Otto K. N., and Wood K. L., 2001, *Product design: Techniques in reverse engineering and new product development*, Prentice-Hall, Inc. New Jersey, USA.
2. Ulrich K. T., and Eppinger S. D., 2000, *Product design and development*, McGraw-Hill, Inc, USA.
3. Wall M. B., Ulrich K. T., and Flowers W. C., 1992, “Evaluating Prototyping Technologies for product design”, *Journal of Research in Engineering Design* **3**(3), Springer International, New York, USA, pp. 163-177.
4. Bhushan N., 2007, “Set-based concurrent engineering (SBCE) and TRIZ – A framework for global product development”, Wipro Technologies, India.
5. Sobek D. K., Ward A. C., and Liker J. K., 1999, “Toyota’s principle of set-based concurrent engineering”, *Sloan Management Review* 40.2.

