Top 10 Equipment Field Agent Construct Establish Set-Based Design Principles in Solution Space

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Weapons Systems Product Design is an issue of information processing in which the information that characterises requirements for product to be converted into knowledge about a product. One of the challenges designers deal with in product design is a lack of detailed information. At start of design process, less is known about the design problem at hand.

Establishing field agents for product/process design creates agent-based tools to construct market places among members of a distributed design team to coordinate set-based design of a discrete build product. Designers of components are empowerd to "Buy" and "Sell" desired characteristics engineers are motivated to assume.

Here we describe the entities interacting in the market space and outline the market space required to make trade-off decisions on each characteristic of a design. Agents representing each component "Buy" and "Sell" units of these characteristics. A component that needs more latitude in a given characteristic, i.e. more weight can purchase increments of that characteristic from another component, but may need to sell another characteristic to raise resources for this purchase.

Set-based approaches focus on keeping design space as open as possible for as long as possible and fully explore design space comprise sets of design options. Design work to be continuous or mentioned one by one as discrete design options depending on the level of specific designs to not be considered alone.

More realistically set of options to remain in design space and considered feasible. Instead of specifying single design before all constraints are known, design decisions are postponed until the Last Responsible Moment-- point at which failing to make the decision eliminates an alternative.

Most design processes are characterised by generic core stages to include establishing requirement, creation of task order, concept design, detailed design and implementation phase. The design process progresses through these stages in repeat fashion.

At each stage, product design exists within a distinct level of the available information termed 'design state' As information passes through the stages, it is punctuated by process decisions aimed at eventual final state where it represents the design solution.

Processes starts with large design alternatives covering broad design spaces to converge to possible design by eliminating weakest alternatives rather than choosing one "best" alternative.

The functional view drives most designs, since it distinguishes the disciplines in which engineers are trained and in support of available design tools. Conflicts arise when different teams disagree on the relation between the characteristics of their own functional pieces and the characteristics of the entire product.

Some conflicts are within the design team: How much of a mechanism's total power budget should be available to the sensor circuitry, and how much to the actuator? Others face design off against other build functions: How should we balance the functional desirability of an unusual machined shape against the increased expense of creating that shape?

During progression of design process, information about design problem and knowledge of the associated design space is increased. This allows for fundamental understanding of the design space guide designers towards realisation of solutions.

Set-based design approach reduces the cost of taking back a decision earlier made; so there is more room to improve the concept while designing it. Cost of repeat action is minimised by not only reducing number of repeat actions but also substantially improving repeat time. In some cases, dependencies models between characteristics may help designers estimate their relative costs, but when models do not exist, prices set in the marketplace define the coupling among characteristics.

Designer seeks to embed a set of functions e.g., optical, electromechanical, control in an object not at time present but occurs as result of the preparation with specified characteristics e.g., weight, complexity, materials, power consumption, physical size.

It is easy to represent how much a mechanism weighs or how much power it consumes, but there is not disciplined way to trade off weight and power consumption against one another. The more characteristics involved in a design compromise, the more difficult the trade-off becomes since solutions are available only in specialised/limited field expertise niches.

In current practice trade-offs are sometimes supported by processes such as quality function deployment or resolved politically, rather than in a way that optimises the overall build design The problem is compounded when design teams are distributed across different job divisions.

The design process progression at any point is dependent on the information generated in the earlier phases as well as the decision making that has preceded the stage. Bad decision making events in later phases of project process do not have much impact on cost and are far less time-consuming than if these would have been made in beginning.

1. All functional engineering design divisions identify solution space independent of others

2. Communication between engineering divisions is based on Design Spaces – Not on Single Ideas

3. Design remains functional after variations in its solution space

4. Determine if Design still fits the solution space after some time

5. Create Designs that work regardless of what the rest of the team decides to do

6. Consider multiple concepts in parallel – create prototypes and eliminate those not working out

7. Each concept is assessed from reasons why concept is/not still feasible also impact of problem in overall product

8. Overlap of feasible design spaces of different sub systems will directly translate into acceptable solutions

9. Taking late decisions means more importance given to decision and more effort should be spent

10. Solutions to meet customer requirements based on avoiding parts not equal so agreement with any party involved in process