

Design Thinking and Product Conceptualization & Development

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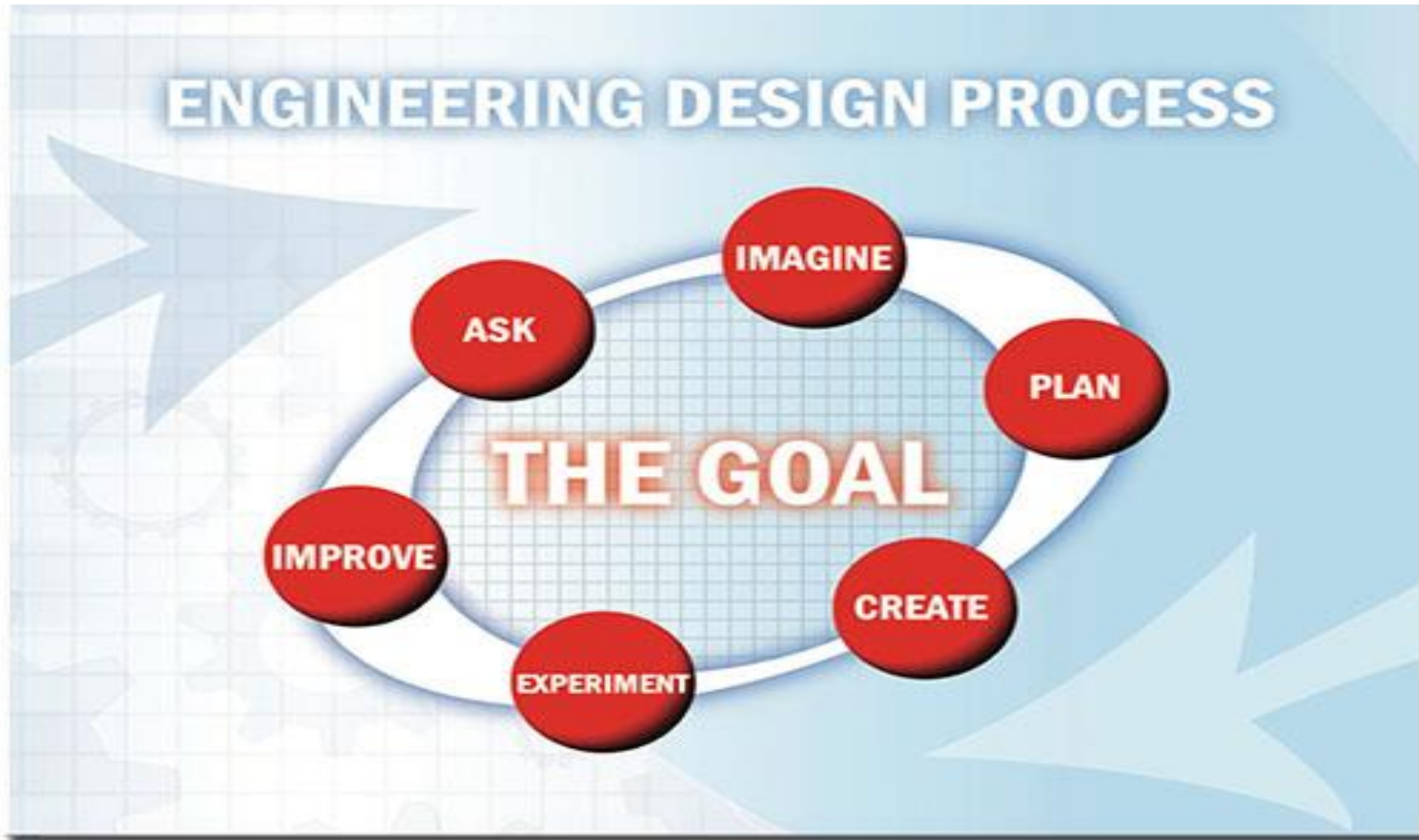
A Perspective on Innovation: Design Thinking and Product Engineering Design and Development

- ❖ Design Thinking is an **innovation process inspired by empathy for the user's needs** followed by **ideation and implementation**, particularly **influencing new product design and development** as it is a means **to direct and focus design and development that results into effective commercialization**.
- ❖ Design Thinking in **the context of product development** commonly outlines the aspects like, **Empathizing** with users and potential customers, **developing insights** and grasp **user experiences and problems**, **ideating for problem-solving** in design engineering, **building prototypes**, **MVP** (minimum viable products) for **feedback** on the product, which is **obtained by testing** with the user and customers.
- ❖ It however, can be **perceived that Design Thinking** is immensely efficacious in the **front-end part of engineering development** and that **can yield a great product concept** which can productively be the candidate for high fidelity prototyping.

Design Thinking to be supported through EDP

- ❑ To **solve engineering problems**, engineers follow a **series of steps** called the “Engineering Design Process (EDP)”
- ❖ ‘**Engineering Design Process (EDP)**’ is a decision making process (often iterative) in which the knowledge STEM (Sciences, Technology, Engineering and mathematics) are applied to convert resources optimally to realise a stated objective.
- ❖ Among the fundamental elements of the design process are the establishment of objectives and criteria, analysis, synthesis, construction, testing and evaluation
—Accreditation Board for Engineering and Technology (ABET)* in USA
- ❖ **EDP** as an **umbrella** covering several aspects, focuses on ideation, research, conceptual design, feasibility assessment, establishing design requirements, embodiment/ system-level design, detailed design, manufacturing planning, tool design, testing, and production piloting. (**Explained with NASA’s Model**)

NASA's BEST Engineering Design Model (designed to teach students the EDP)



Engineering Design Process (NASA): The steps are described as follows

- ❖ **ASK (To identify a need):** Identify the problem, requirements that must be met, and constraints that must be considered.
- ❖ **IMAGINE (To develop possible solution ideas):** Brainstorm (think up) problem-solving ideas and research into them; also explore available alternatives.
- ❖ **PLAN (To decide the best course or the design concept):** Choose a couple of top ideas from the 'thought up' list and draft possible design solutions, and finally select the most suitable one as the design concept for prototyping.
- ❖ **CREATE (To develop a Prototype - a test model of the product):** Build a working model, or prototype, that meets the design requirements, while complying with the design constraints.
- ❖ **EXPERIMENT (TEST To evaluate the prototype and Cost-Benefit Analysis):** Evaluate the solution through testing for functionality and quality; collect test data and analyze for determining the fitness and flaws of the design.
- ❖ **IMPROVE (To modify and retest the solution):** Carry out improvement iteration on the design by identifying changes to be incorporated, based on the test results.

The alignment of EDP and DT is presented in the following slides

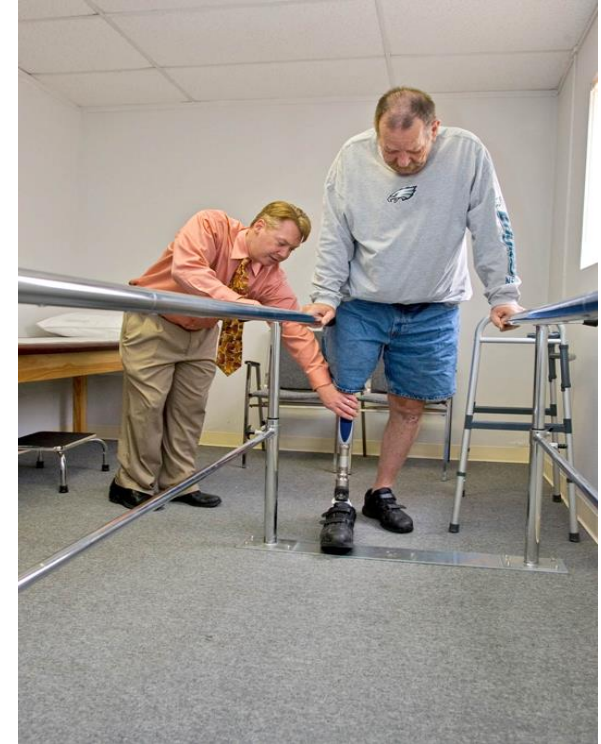


STEP 1- ASK

(Images from Science Photo Library)

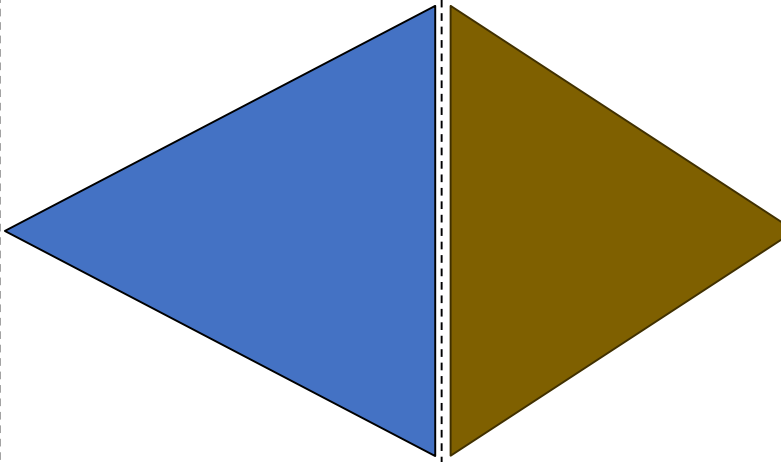
‘Ask’ refers to ‘What is the need?’

- ❖ Identifying the need or problem or challenge that is being tried to be solved by researching into and properly defining it
Example of need: To provide prosthetic support/ devices when a person has lost a limb
- ❖ Using ‘**Design Thinking**’ principles engineers would observe, study and analyze and define:
 - (i) Precise needs of individual for the specific disability (**Empathy**)
 - (iii) Biomechanics concerning the particular case
 - (iii) How the available prosthetic devices are not providing comfort or meeting other requirements, and
 - (iv) **Define** ‘what is exactly to be built’, which is based on the tenets of ‘Analysis’ and ‘Synthesis’, of the information gathered at Empathy stage in DT



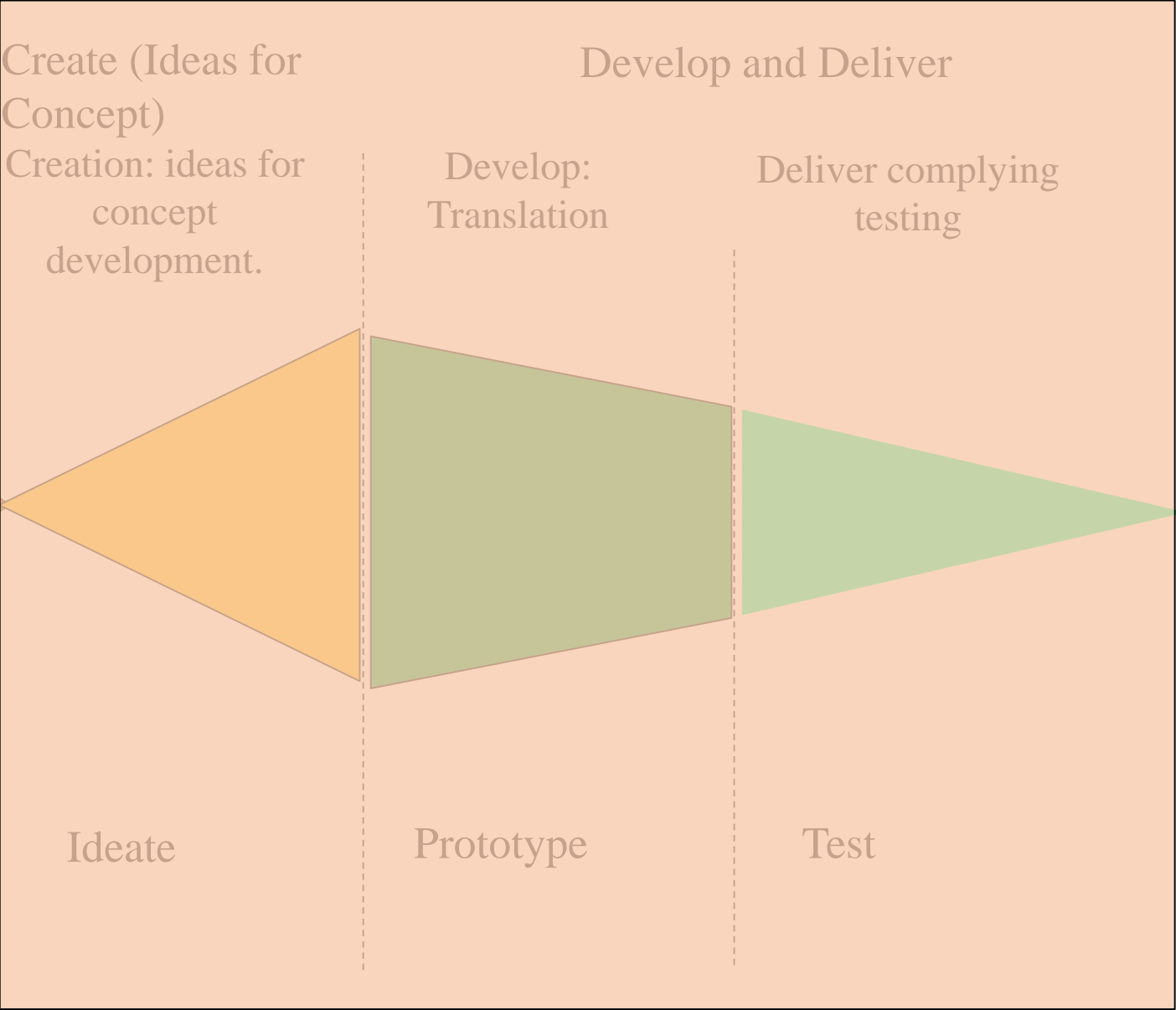
Understand Opportunity

Understanding culminates in insight.



Empathy

Define



Create (Ideas for Concept)

Creation: ideas for concept development.

Ideate

Develop: Translation

Prototype

Develop and Deliver

Deliver complying testing

Test

STEP 2- IMAGINE

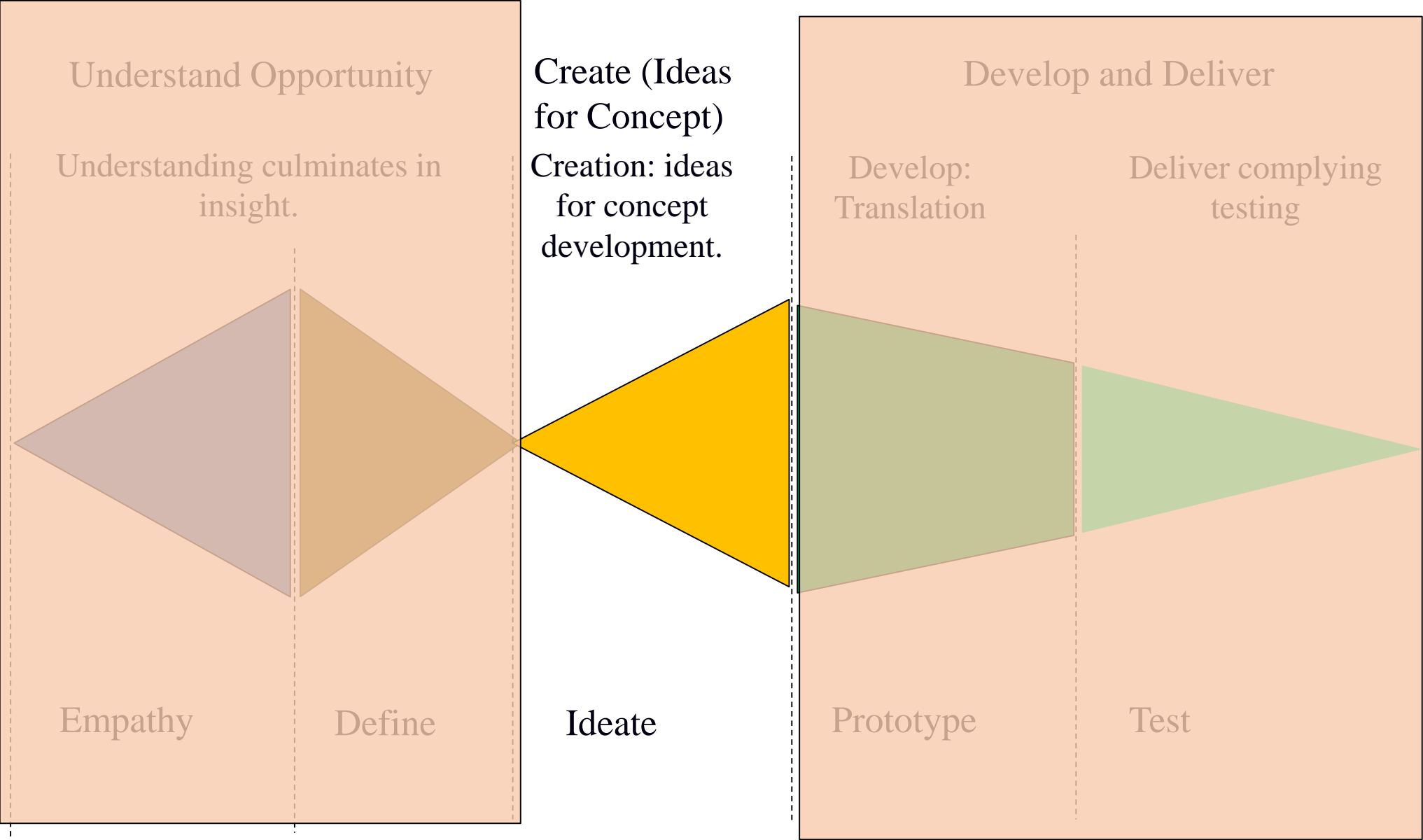
'Imagine' refers to 'Generate Ideas'

- ❑ **Brainstorming for problem-solving ideas** - Sharing ideas; so as to build one on another.

Example of Ideation: A prosthetic foot designed copying car springs.

- ❖ This, according to Design Thinking' practice is to '**Ideate**'. To cultivate the best solution ideas for a defined problem, through Brainstorming, using creativity with Innovation orientation.
- ❖ This is required for **(i)** asking the right questions to innovate, **(ii)** enhancing quantity and variety in innovation options, **(iii)** looking beyond the obvious solutions to increase the innovation potential solution, **(iv)** hitting upon the unexpected areas of innovation, as followed in 'Design Thinking'





STEP 3 - PLAN

'Plan' refers to Concept Planning

Evaluation of Ideas and selecting Concepts for prototyping.

- ❖ To '**Ideate**' in Design Thinking in reality is '**conceptualization**' in true sense, since ideas are evaluated and the best ones are screened out following the precepts of Design Thinking (DT).
- ❖ According to some DT model the innovative concept is considered to be present at the intersection of user desirability, technical feasibility and economic or commercial viability.

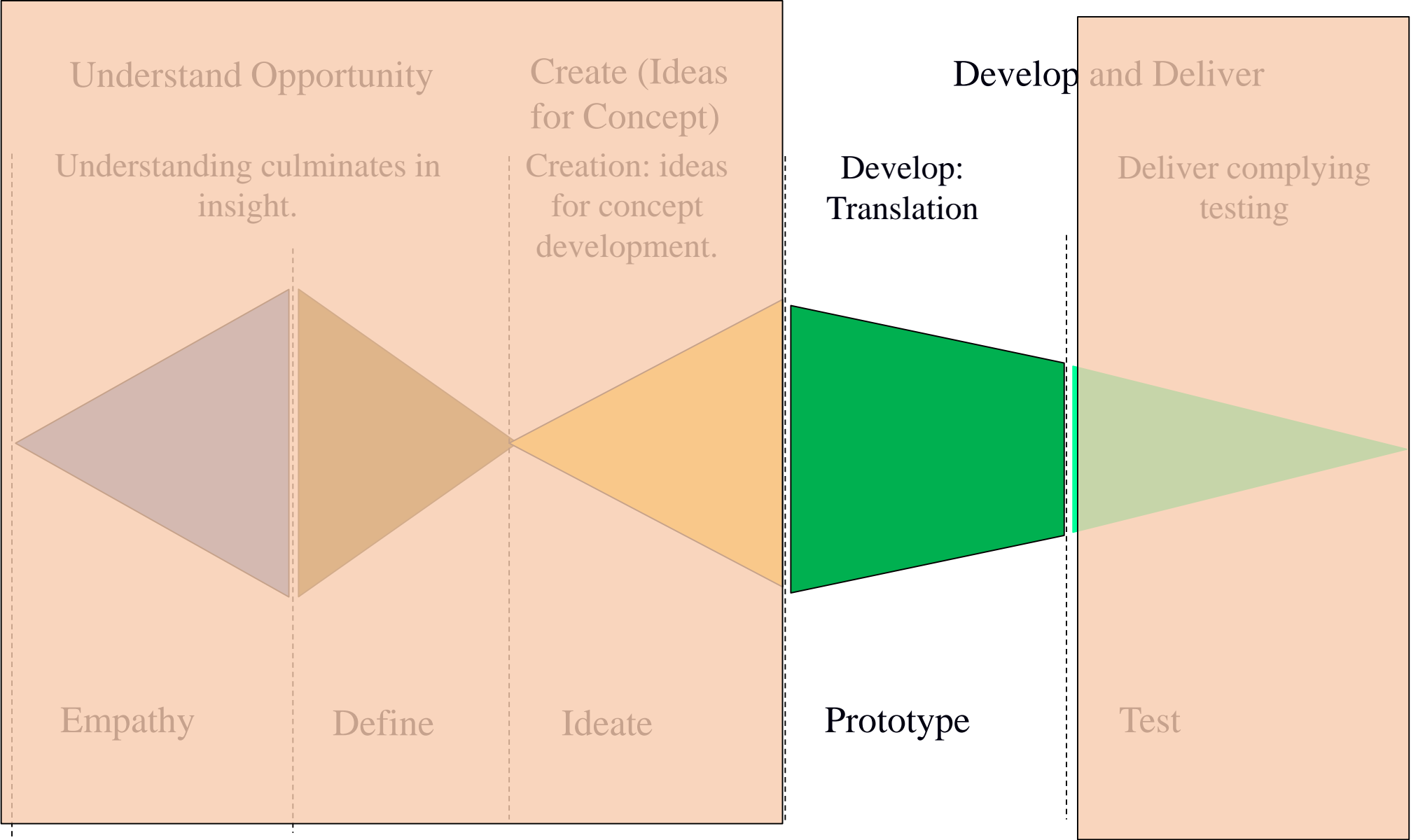


STEP 4 - CREATE

‘Create’ refers to ‘Building Prototype’.

- ❖ Building a **prototype** (a test model of the intended product) will allow the developer to see if the design works the way it was expected to.
- ❖ A physical prototype may, or preferably, follow a ‘digital’ prototype (using CAD/ CAE) for economic and temporal reasons.
- ❖ The strategy in ‘Design Thinking’ emphasizes on prototyping for testing with the user rather early to obtain feedback.



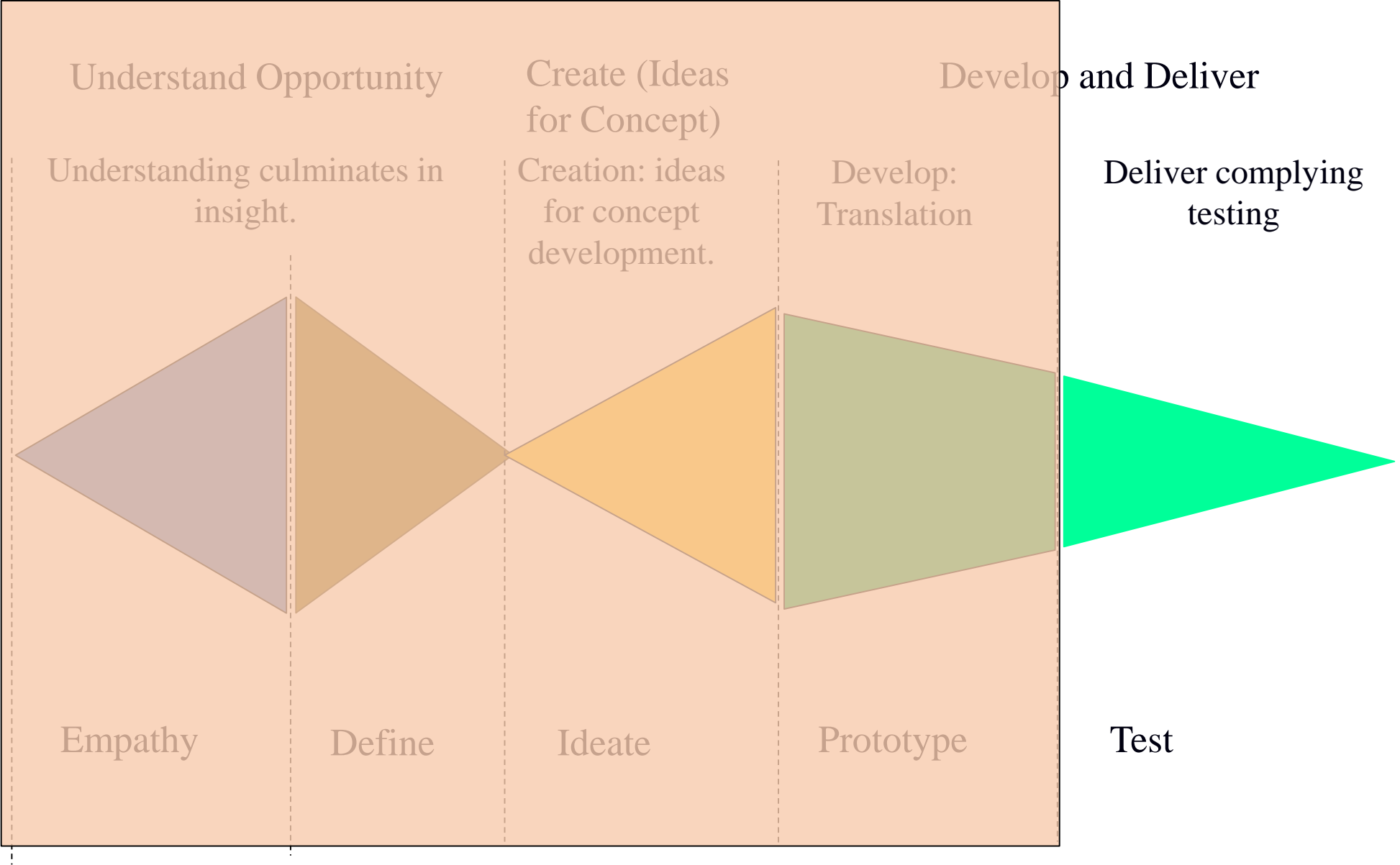


STEP 5- EXPERIMENT (TEST)

‘Experiment/ Test’ refers to evaluating the prototype.

- ❖ To insure that the technology/ product/ solution accomplishes the task it was designed for the end user.
- ❖ To ascertain what the cost of developing (designing and manufacturing) the new product is worth in terms of benefit **(Cost-Benefit Analysis)**
- ❖ Obtaining feedback is crucial in design thinking, which often is an iterative process since development is prone to fail if the ‘need understanding’ is not accomplished using prototypes.
- ❖ The experimentation and testing of the prototype through iterations bring the product to its acceptable version





STEP 6- IMPROVE

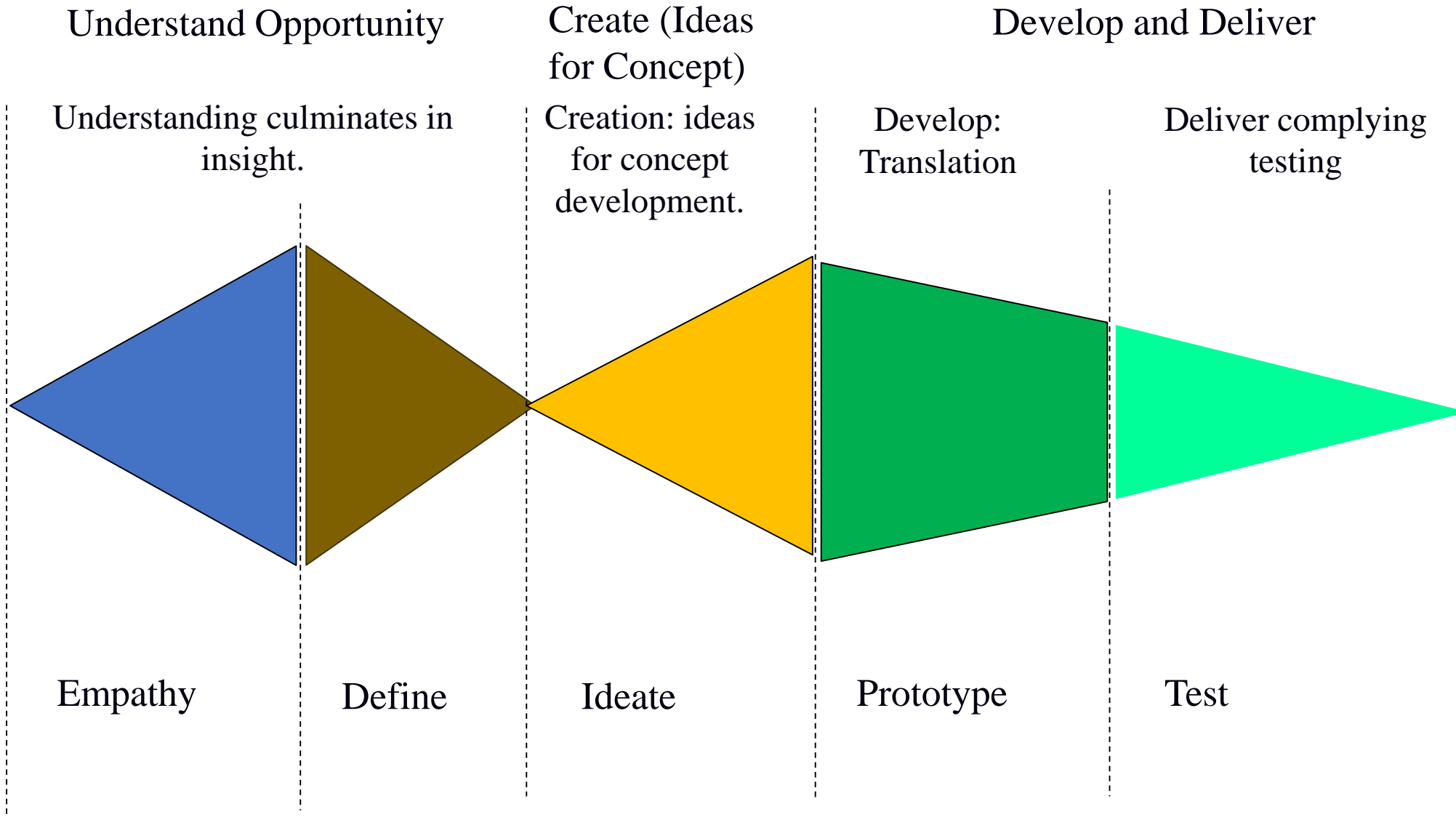
‘Improve’ refers to modifying and retesting the prototype.

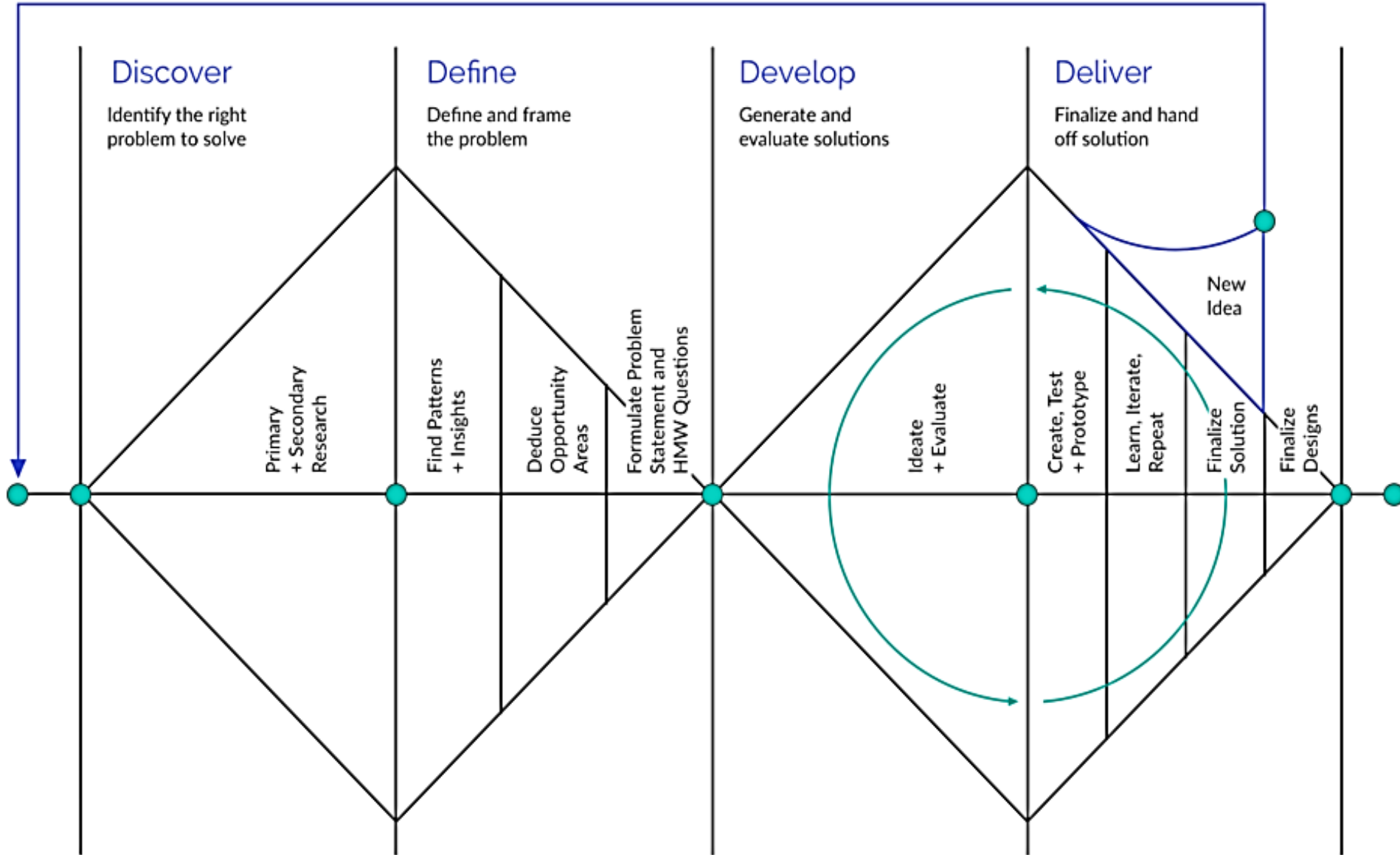
- ❖ Till the prototype work successfully, the engineers may prefer to modify it or plan a new solution. Such modification may also be due to alternate uses as requirements generally would also be to scout around for other possible uses for the developed product.

Example: Computerized Tomography (CT) scanning was developed to see internal structures in the body, which is used also for modeling limbs for better fit of prosthetics.

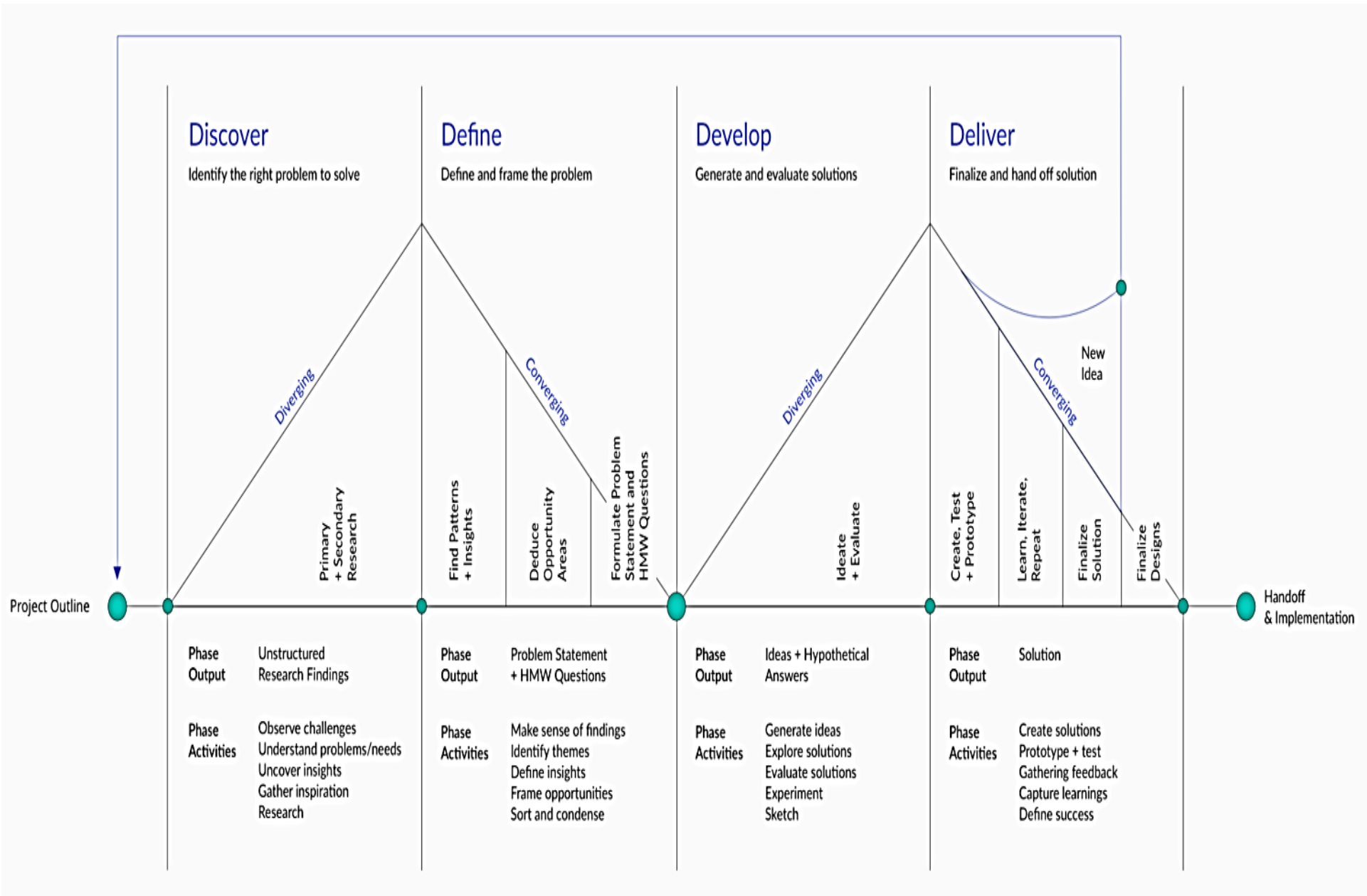
- ❖ According to DT paradigm, if the users are facing problems in the present solution then the design team must rethink and develop an useful version.







Source:
<https://www.meret.design/double-diamond>



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<https://www.meret.design/double-diamond>

DT's influence on Design Conceptualization

- ❖ It can well be understood that Design Thinking has the intertwining with the Product Engineering Design and Development process.
- ❖ It especially influences the front-end of innovation and development and particularly in product design conceptualization.
- ❖ Retracing from a DT model for the steps in product conceptualization development corroborates the above as is depicted through the last two diagrams.

Thank-You