KPIT | SPARKLE

2021

Mobility & Energy for the Future

Harnessing nation building ideas from ‘Bharat’

Example of virtual prototype

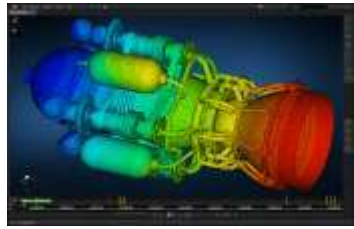
Aspects of Rocket Design: A Virtualized Product Design

Initial Mathematical Calculations or Optimizations

Component Wise Mathematical Modelling

Physics based validation

Design validation of individual components using FEA



Iterations based on system level constraints on virtual platform

Adaptive

Minimum reqd. in case of virtual prototype

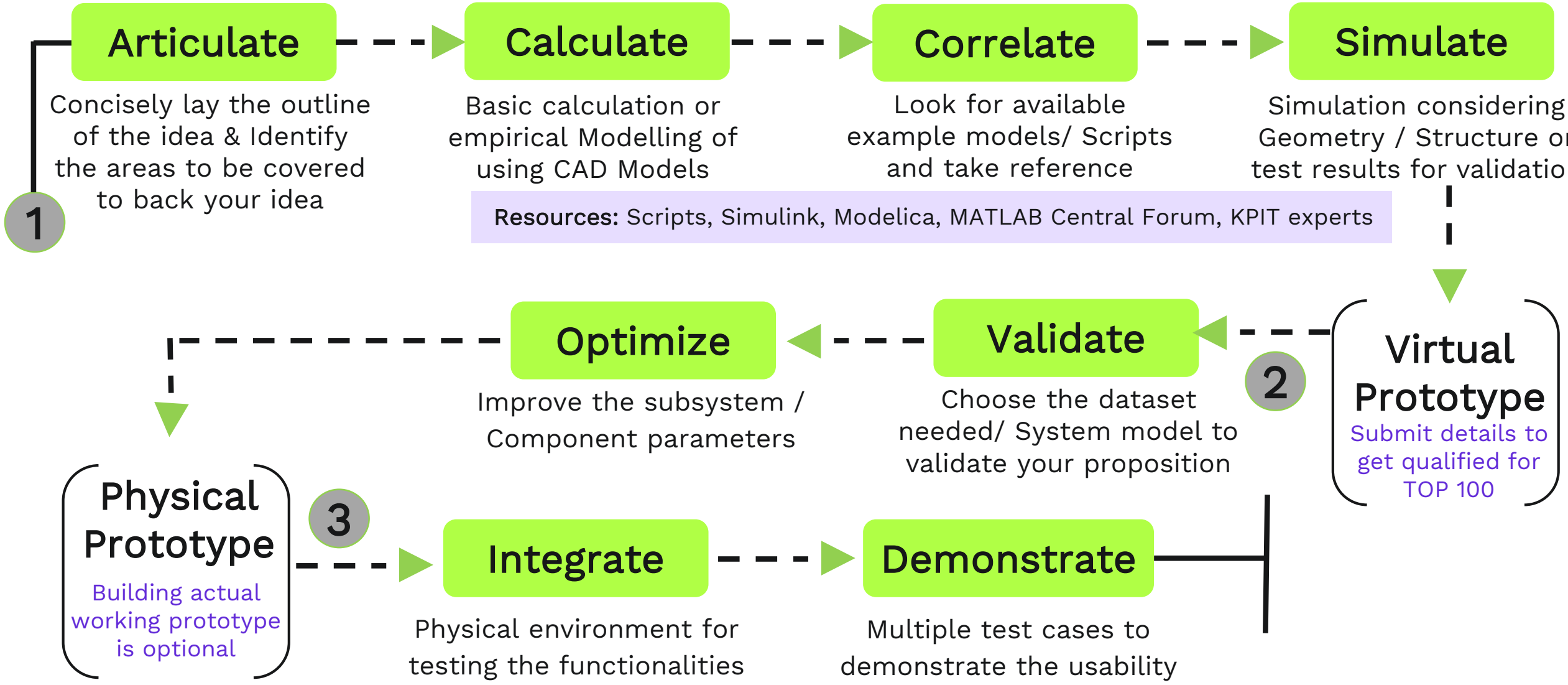
Hardware Integration

Integrated Hardware to be checked for the test cases and imminent fault diagnosis

Physical prototype: Initial testing and reports on performance w.r.t. benchmark product

Successful Integration

Process to build prototype



Simulation for the Product/ Service- virtual

Area of Work: Electric Vehicles, Hybrid Electric, Charging Infrastructure and other related fields.

- Develop simulation model to demonstrate feasibility of concept, robustness of control, performance measures, environmental considerations, product appearance etc.
- The virtual prototype shall include all kind of physics which can affect the characteristics, performance and life of the product.
- There should be modular architecture where functions of each module (SW/HW) shall be validated separately and integrated.
- All the models shall be properly parameterized which can be initialized, modified and integrated using a single script or graphical interface.
- Physical models should include features of hardware in the loop testing that can eventually help in hardware development and validation process.
- The virtual prototype shall be mature enough to analyze performance, reliability, durability, cost, size, weight etc. and possess systematic and quantitative method to improve any of them.
- Validate the virtual prototype with co-simulations in case of multi-physics involved and verify that the real target would not malfunction or damage itself due to operation out of range.

Simulation for the Product/ Service- virtual

Area of Work: Autonomous vehicles, ADAS, Machine Learning, Artificial Intelligence, Deep Learning , telematics and other related fields

- Be unique and clear about the problem being targeted
- No copy-paste of solution from internet
- DATASET: Quantity and quality and availability of datasets
- Bench-marking (accuracy, running time) on multiple algorithms and comparison with already existing literature
- Validation of developed algorithm on multiple test cases and simulator
- Deployment on edge or cloud

Simulation for the Product/ Service- virtual

Area of Work: Mechanical, Renewable energy , Passenger safety, road safety solutions, Fluid Mechanics, Thermodynamic , Hydrogen fuel cell, Hydrogen generation related work etc.

- Be crisp about the problem you are addressing and devise a proper methodology for the solution
- Explain the edge of your solution over the existing ones.
- Detailed Calculations supporting your solution should be made.
- Pertaining to some problems, Theoretical calculations might not be substantial to prove the efficacy of your solution. In such cases, CFD/CAD/FEA analysis should be made to further strengthen the effectiveness of your solution.
- If you are performing CFD/CAD/FEA analysis, try considering extreme scenarios along with a most common scenario. Also consider the external factors affecting your solution such that the error in prediction can be minimized.
- If one can prepare a physical prototype, a detailed video depicting the results should be submitted.
- If one is only going for a virtual prototype, apart from the preliminary calculations and the CFD/CAD/FEA analysis, an economic viability study of the solution should also be made.

Simulation for the Product/ Service- virtual

Area of Work: Battery chemistry related, Hydrogen fuel cell chemistry, Hydrogen generation related work etc.

- Select the problem statement that is relevant with respect to state of the art of battery technology
- Please specify if the simulation problem is suitable for a particular battery chemistry or is it chemistry agnostic?
- Could provide calculations using basic principles, comparison of cost of the new material, performance measures against benchmark, showcase your experimental data to prove.
- Some possible problem statements are as follows:
  - Finding new possible cathode and anode materials from theoretical considerations
  - Mathematical modelling of defects generated during electrode coating
  - Mathematical modelling of effect of area ratio of cathode to anode
  - Mathematical modelling of electrolyte wetting and soaking behavior in cathode, anode and separator
  - Mathematical modelling of effect of tab size and position on performance of high-power battery
  - Mathematical modelling of degradation due to localized delamination of coatings during battery operation
  - Mathematical modelling of battery degradation
  - Estimation of state of health and state of charge in battery
  - Mathematical modelling of pressure generated within pouch cell when anode or cathode is undergoing volume expansion.
- Verify the model results with some experimental data.

Intellectual property rights (#IPR) & Product Innovation

Some Examples of Invention, Disruption and Innovation see sample videos of prototypes in Helpful resources

Tan 90

A Portable Cold Storage (Raised 1cr Funding)

Bioelectric Toilet

(Swachh Bharat Initiative implemented at IIT Kharagpur)

Invention + Disruption

Innovation

Innovation

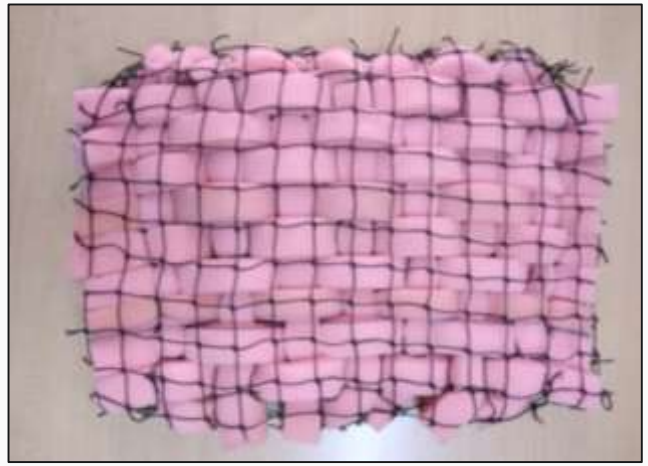
Invention

Driverless Tractor

(Technology collaboration with Mahindra & Mahindra)

Oilio

(Oil Spill Recovery by Sponge & Oleophilic Nano)



Theme -"Mobility & Energy for the Future"

Students can submit their innovation by choosing following categories. Participants can submit only one or more ideas

Mobility	Electric Vehicles	New Motor Designs, Motor Control Techniques, Electric Motor Efficiency Improvement, Efficient Thermal Management Techniques for EV components like Battery, Motor, 2/3-Wheeler EVs
	Hybrid Electric	Supervisory Controls for HEVs, New transmission designs for HEVs
	Hydrogen Fuel cell for Automotive	Integration of Fuel Cell Stack in Vehicle, Alternative to Nafion Membrane, Thermal management of Fuel Cell
	Charging Infrastructure for Electric Vehicles	Smart Chargers, Fast Charging of Evs, Wireless Charging of EVs (IEC 61980) AC/DC Chargers (IEC 61851)
	Machine learning/ Artificial Intelligence for Automotive	ML Based Diagnostics for Evs, Deep Learning for Vehicle Parking, Detecting Traffic Rule Violations
	Telematics for 2/4 wheelers	In-Car Speech Recognition (Alexa Integration), Bike Navigation Systems, Telematics for Vehicle Fleet Operations (Goods Transport/Taxis)
	Road, Vehicle, Passenger safety, Shared Mobility	Smart Helmets, Reducing Tire Bursts, Better Visibility for Night Driving Accident Prevention, Platform for Multimodal Transport
	Post COVID-19 (Pandemic) Solutions	Sanitization solutions, Social distancing models in public transport, solutions for masks, Self-Sanitizing material in Vehicle, Proximity alert mechanisms, Innovative Air quality systems. in Vehicle

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Energy	Energy Storage Technologies	Novel, Low Cost, Earth Abundant Electrode Materials for battery, Novel Electrode Architectures, Solid Electrolyte, Hydrogen Storage Challenges, Solid State Batteries
	Energy Generation Technologies	Hydrogen Gas Production and Collection by using Techniques related to Bio-Fuels from Bio-Mass, Improvement in Hydrogen Generation using Electrolysis, High Efficiency Power Generation Technologies
	Hydrogen Fuel cell for Automotive	Integration of Fuel Cell Stack in Vehicle, Alternative to Nafion Membrane, Thermal management of Fuel Cell
	Renewable Energy Solutions	New Materials in Solar Photovoltaics, Compressed Air Solutions, Solid Oxide Fuel Cells
	Sensors - Actuators for Automotive	Nanomaterials, Biomaterials for Sensors / Actuators, Sensor Fusion

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