Development Tracking for Model making and Rapid Prototyping Practise Based in Industrial Design Education Design Studio

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ABSTRACT

This study is conducted to better understand the benefits of the Conventional Model Making (CMP) in Industrial Design learning at higher institutions in today's industrial innovation. The emergence of technology such as three-dimensional printing (3DP) or Rapid Prototyping in the possess challenges in the design educa-tion. This trend changes the conventional ways of making products which indi-rectly affected the CMP process. The study will focus on how the CMP process is conducted by students and what they can learn from the process compared to the three-dimensional printing (3DP). The researcher will conduct a focus group study to understand this phenomenon.

Key Words: Rapid Prototyping, Industrial Design Education

INTRODUCTION

Authors The rise of technology in Rapid Prototyping has change the world on manufac-turing. Three-dimensional printing (3DP) has been made available for individual use around the world which effects on how manufacturing industries and Product Design industries in producing designs and manufactured them. According to Sundaram (2016), the 'Internet of Things' will influence product innovation, con-nectivity and mobility, and big data analytics. Kalay (2005), agrees on the chang-es brought by this latest technology revolution by changing the conventional de-sign process into a 'network of design, manufacturing, marketing and manage-ment organizations. Conventional product design process requires the designers' involvement through social, cultural, and consumers' research before producing design, thus time-consuming. With the latest revolution in technology of manu-facturing, the process can be done within days of sharing information via internet networking around the globe.

There are already many companies such as Nest, 3D Hubs, Local Motors and more which produce designs and products for industrial use, makers, and even for consumers use Park (2016). Manufacturing industries, hobbyists, makers, and consumers can communicate with these companies in producing products for market use or personal use.

Technology revolution such as the Rapid Prototyping would definitely changes the means of product design process in industries. Affected by this revolution is also the product design learning in higher institutions. It could change the design process teach in product design learning. One of the affected processes is the Conventional Model Making Process (CMP), which could be replaced to Rapid Prototyping process such as 3D Printing.

CMP is a final ideation process in Product Design process. As Isa & Liem (2014), categorized Physical models into four categories; 1. Soft Model, 2. Hard Model, 3. Presentation Model and 4. Prototype. In automotive design, Shahriman, (2012), considers it as aesthetic development and styling. According to him auto-motive development is defined as 'the study of sensory or sensory-emotional val-ues' (p. 1). CMP is the study of form which refers to visual appearance. The com-plexity of forms can be studied and explored by students in understanding the myriads characters of forms. Based on his findings, Sany (2016), found that CMP benefits future designers in craft skills (aesthetics and tactile sense), machin-eries utilization (woodworking and metal machines, and materials understand-ings), and marketing (costs study and brand study). The understanding of forms is important to future designers as it will give them the advantage of critical thinking while designing.

TRADITIONAL MODEL BUILDING WITHIN INDUSTRIAL/AUTO DESIGN

Physical model-making is the process of creating physical replicas of designs (Orr, 2008), at a reduced scale compared to the actual size of the object. Scale models have always been a very important part of the curriculum for Industrial design schools. Models are used by students to understand form and space, figure out complex designs, convey design solutions and as a presentation tool. Physical models are used as visualization tools that overcome the limitations of two-dimensional (2D) images (Tucci, Bonora 2011). Students are taught the basics of model-making right in their freshman year where they create sketch models .The skills acquired are carried forward to the design studios. In the design studio, the model building process begins with design sketches; once a design has been final-ized and drawings prepared (either hand drawn or computer aided) the scale of the model is decided, materials selected to create the model and the building pro-cess begins. The building process has three main steps, (1) drafting the model out-line onto the material selected to build the model, (2) cutting out the pieces, and (3) gluing the pieces together to create the desired shape. Though model building is a very effective tool in communicating design ideas there are numerous draw-backs to building a model which include but are not limited to poor quality, hu-man error (Agarwala et al., 2009), time constraints and disinterest on the part of the student.

DESIGN PROCESS

The student works on a selected research topic under the guidance of their lectur-ers was undertaken during the final semester. 5 weeks of preparation were given as part of the semester 5 final year project. Selected students from transport de-sign major were selected during the observation of the model making process. A total number of Four models were built by students were used for this investiga-tion. These models were scaled to 1:7 as requirement for the final model project.

Models A & B were built using the RP subtractive process done with a Roland MDX-540 series A machine. Materials used for the core model were soft wood 'Jelutong' glued and pieced together to make a solid block of approximate 20cm x 20cm x 100cm. The material dimensions are prepared according to the RP ma-chine operation and limitation. For model B & C, an existing built process were chosen using a conventional foam and automotive putty filler. All models were sanded to have the finished look and treated as a main criterion for the study.

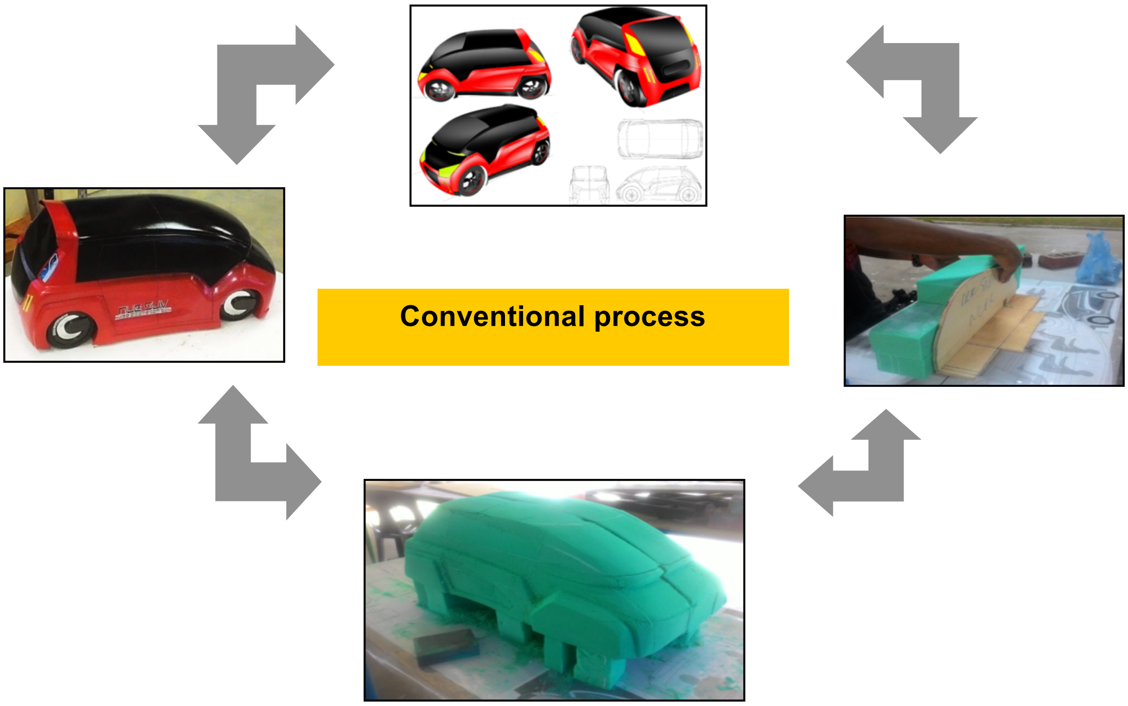

Figure 1: The flow of conventional process

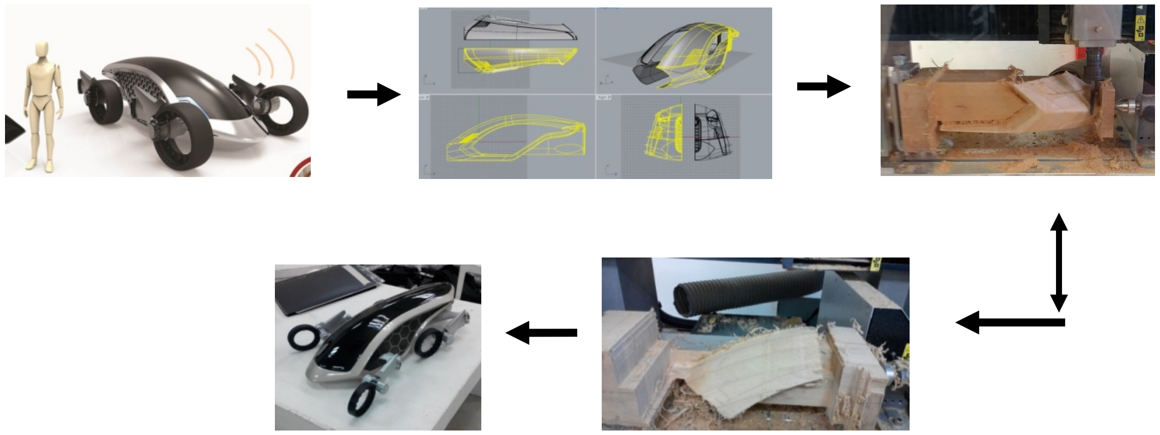

Figure 2: The flow of Rapid Prototyping process

Table 1: Model Making processes for both Conventional and Rapid prototyping

Conventional process	Rapid Prototyping process
2 Dimensional sketch/renderings	3Dimensional renderings/Data
Package Dimension	Conversion data/ parts
Scaling of model	Machining setup
Material Selection	Cutting and forming process
2D drafting on Model	Removing material support
Forming of model	Checking part reliability
Model refinement	Parts assembly

The prototyping processes for both CP and RP are relatively similar in relation to the goal in achieving a good representation model derived from the design briefing and ideation stage. The diversification of process shown in Table 1 provides a general overview of approaches to modeling which could outweigh one or the other. The arrow visible in each column represents the linear downwards and up-wards workflow of each process. Understandably the process of CP is more for-ward work where every step is carefully considered before moving on to other next process. The creation in RP differs in respect of the creation data which later could be duplicated over if necessary. Identification of each approaches gives more insight in the timeframe investigation.

Table 2: Taxonomy of skills for design process

SKILLS	A	B
Sketching		
2D sketching	✓	✓
2D digital drawing	x	✓
Model Making (scale)		
Conventional model making (foam, fibreglass, wood, etc.)	✓	✓
Rapid prototyping	x	✓
Computer Skills		
CAID (Computer Aided Industrial Design)/ 3DModelling	✓	✓
Auto design surfacing (e.g., Surface A,B or C), CAS	x	✓

A preset of taxonomy of skills is introduce to both students A and B as means for capability. As shown in table 2 above, these presets acknowledge the sets of skills which the students should have in handling the projects. The subsequent ticks and crosses are not necessarily reflects these individual capability. It is used to inform the different skills needed in both processes.

A subtle and firm measurement is also considered to form this investigative approach. Likert scale will be calculated by giving a certain weightage to each point on the scale and the average score for each individual item Salkind (2000), a. Counts 1 to 5 will be used as base scores of items in assessing the comparing timeframe or development in model making progress.

Table 3: Example likert scale for measure weightage in progress making

Poor	Below Average	Average		Good	Excellent
1	2	3		4	5

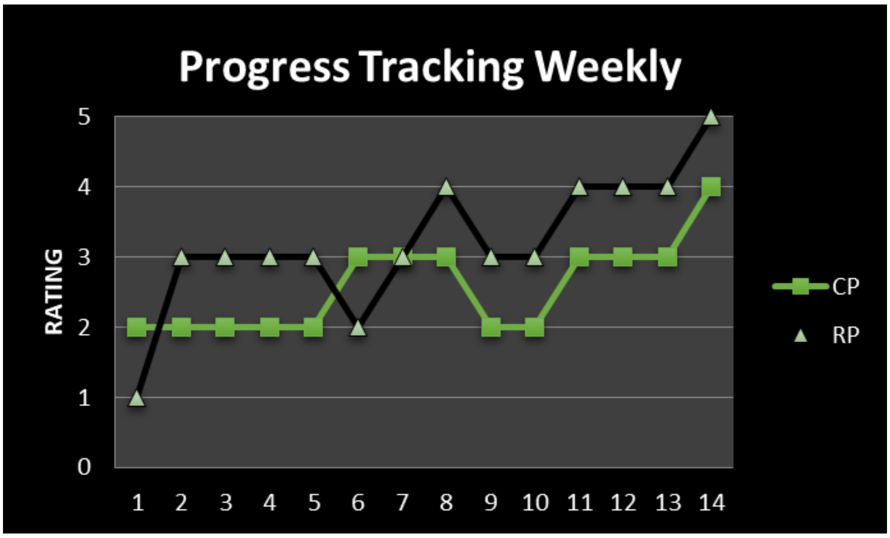

Figure 3: Progress tracking weekly progress chart.

RESULT

In perceptions for prototyping forms, this model making procedures utilization was noted through observation in a weekly basis. As figure 3 shown above, it preludes the process stream for both the conventional CMP and RP forms.

The two models subsequently gave a relatively different timeframe and being tracked by its progresses. While processes using RP models were seen to have better output in the weekly. Utilizing the RP process allowed the student in better coordination of model to be more exact duplicate in respect of the previous 3D data creation. In conventional CMP, There is signs of inconsistency when forming the model as seen in week 10 until 12. Although Process B showed similar signs of pressure it is reconciled at the repeated stage

(refer Table 1) .Both processes showed a considerate rank of 4 of model finish at the end of week 14. It is Process B which have more exact feature to the initial idea than process A. The CMP process at the end have more refined finishes due to careful planning although it is being exaggerated to have the dramatic look.

CONCLUSION

These examples have showed a simple physical timeframe could be used to track the development processes and foremost have significant attribute in the model making processes. Assessing timeframe to track model making for industrial design learning will boost more understanding in creating suitable workload for students without undermining creative and critical design thinking skills needed in the subject. It would be recommended for future research to indulge more substantive measurement in development tracking especially in the areas of industrial design education. Recommendation of assessing a larger group for development tracking will enrich significant knowledge insight about the capabilities of tools and equipment used in industrial design learning.

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