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CULTURAL HYBRIDITY: AN EFFECTIVE ADOPTION OF RAPID PRODUCT DEVELOPMENT TO ENHANCE INDIGENOUS CRAFT DESIGNS

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ABSTRACT

The evolution of rapid prototyping technology has provided extraordinary opportunities for new product development and manufacturing improvement. However, its applicability in arts and crafts has been questioned due to the growing concern for tradition and cultural authenticity. Therefore, this paper seeks to explore the area of intersection between rapid product development and artisanal skills. With a specific focus on ceramic craft, the paper investigates on how rapid prototyping technology can be effectively employed to enhance and sustain indigenous craft designs. Based on a broad literature review conducted and field observation, the paper proposed a cultural hybridity approach for effective adoption of rapid product development to sustain indigenous crafts without hampering the originality and cultural authenticity.

Keywords: Cultural hybridity, ceramics, rapid product development, Indigenous Craft, design

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1. INTRODUCTION

Craft enterprises play a significant role in alleviating the condition of the common man by promoting the use of local resources to sustain local productivity that meets the immediate needs of people. Besides, they contribute to jobs creation and promote indigenous knowledge and culture.

However, due to the obsolete hand-made techniques mainly used by craftsmen, the productivity and quality of output products are often affected. Since the production technique has a significant influence on the productivity, cost and quality aspects; hence, employing an obsolete and inefficient techniques will result to poor output products. According to the findings from Doyle's assessment of South African craft, when poor products predominate, it leads to unsuccessful or unsustainable enterprises [1].

Therefore, design is an important aspect of craft production; in other words, [2] stated that crafts and design are intimate partners. The context in which design is used in this study includes the *origination*, the *conceptualization*, the *process of making* and the *final output product*. The origination in the sense that; the authenticity of the craft (such as cultural design features) needs to be preserved. Thus, conceptualization of new products should integrate *tradition* and contemporaneity.

Furthermore, it is important that the final output product is of good quality. This has been indicated in several research findings that a high-quality product is one of the most important keys towards successful craft enterprises [1]–[3]. But then, it is impossible to produce high quality or superior designs without using appropriate techniques or technology.

For example, in ceramics production, the forming technique have been one of the innovations that have profound consequences for the craft development [4]. In order to speed up fabrication process and increase productivity, several researchers have explored a wide range of techniques. The first technological innovation that increased the efficiency and speed of production is the development of the potter's wheel.

However, the disadvantages of the throwing technique are that; potters are only restricted to round-shape designs and the method cannot produce multiple similar products. Thus, to ease the production process, and also improve product quality, a casting production technique was developed (Fig. 1). This technique begins with a well-conceived design, developed into a prototype by hand carving or hand turning the design. But this process of hand-carving or hand turning the design in plaster mould is time-consuming, highly inaccurate and demands skilled persons that are difficult to find and too much time-consuming to train [5], [6], [7].

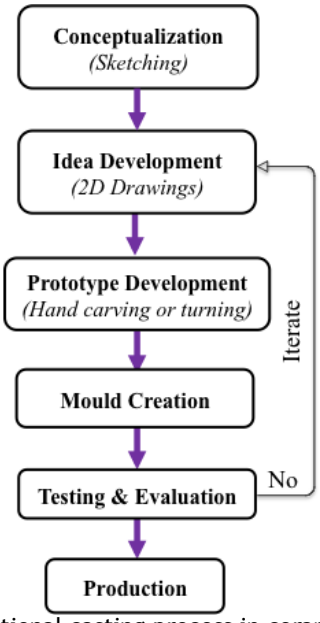


Figure 1: The traditional casting process in ceramic arts and crafts

Even though slip casting is a mass production technique, however, it is not only used in traditional manufacturing industries but also among arts and crafts industries [8]. This is because the casting process also requires handicraft skills and some tacit knowledge. Therefore, in ceramics production, the lines between crafts industries and traditional manufacturing industries have been blurred. In terms of the production processes, both industries utilise natural media (such as ball clay, kaolin, porcelain), artisanal skills (such as carving) and hand tools or simple equipment (such as throwing or turning wheel).

Besides hand carving and hand turning, manufacturers have also used subtractive technology such as jiggering and jollying, Computer Numeric Control (CNC) and Lathe machine in creating prototypes, but the disadvantage of the technology apart from wasting materials is that; only those form features accessible by the subtractive tools can be created [9].

However, the advent of the twenty-first century has brought alongside the digital revolution (additive technology) where the process of building prototypes start with nothing and build an object incrementally by adding materials. As illustrated in Figure 2, the computer technology/applications incorporated in the design process and documentation enables drawings speed, quick modifications and links up the whole spectrum of design initiation through to the technical aspect. This helps designers to visualise and evaluate designs digitally and explore design alternatives prior to building the physical prototype.

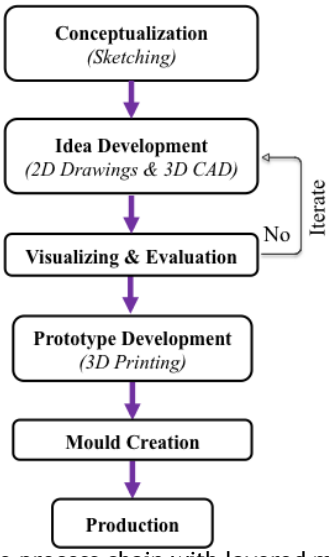


Figure 2: The process chain with layered manufacturing

Therefore, many believe that the evolution of rapid prototyping technologies offers the extraordinary opportunities for new product development and manufacturing improvement. However, some still have the opinion that the adoption of such modern technology in craft production will hamper the originality and cultural authenticity of the crafts.

But then, culture is a dynamic structure that integrates tradition (as required by its historical nature) and contemporary (as required by its liveliness) [10]. Therefore, creating a product requires cultural hybridization that is not solely based on tradition, but also a consideration for contemporary needs. Hence, with a focus on ceramic crafts, this paper seeks to explore how modern technology and indigenous skills can be integrated to enhance the design of indigenous ceramic crafts.

2. STATE OF THE ART IN RAPID PROTOTYPING TECHNOLOGY

Rapid prototyping is the automatic fabrication of physical objects directly from computer-aided design (CAD) data sources. Rapid prototyping technologies are being increasingly used also in non-prototyping applications; thus, the techniques are often collectively referred to as solid free-form fabrication; computer automated manufacturing or layered manufacturing [11]. These systems add and bond materials in layers to form objects. With this additive technologies, objects can be formed with any geometric complexity or intricacy without the need for elaborate machine setup or final assembly [9]

The first commercially available machine based on this principle was Stereo Lithography Apparatus-1 (SLA-1) released by 3D Systems, Inc. in 1984 [12]. There are now numbers of rapid technologies that uses additive principles; these include Selective Laser Sintering (SLS), Fused Deposition Modelling (FDM), Layered Object Manufacturing (LOM) and 3D Printer (3DP). Each of these technologies has their own unique strengths and varying base materials (Table. 1)

Table 1: Rapid prototyping technologies and their base materials [13]

Rapid Prototyping Technologies	Base Materials
Selective Laser Sintering (SLS)	Thermoplastic & metal powders
Fused Deposition Modelling (FDM)	Thermoplastic, eutectic metals
Stereo lithography (SLA)	Photopolymer
Laminated Object Manufacturing	Paper

(LOM)	
Electron Beam Melting (EBM)	Titanium alloys
Direct Metal Laser Sintering (DMLS)	Alloy metals
3D Printing (3DP)	High performance composite

The advantage of rapid prototyping is that any solid 3D freeform can be generated without the aid of external tooling, so most of the problems associated with the subtractive jiggering and jollying, Computer Numeric Control and Lathe are totally sidestepped. Just as shown in Table 2, Rapid prototyping technologies have several advantages compared to CNC and conventional manufacturing processes. These include lower risk factor and nominal time to process the CAD data during pattern building, the absence of secondary or nominal post operation, and the ability to integrate multiple operations in the building process.

Table 2: Comparison of Conventional, CNC, and RP construction methods

Variables	Conventional	CNC Machining	Rapid Prototyping
Operations	Single Operation	Simultaneous operations	Multiple operations
Post-Operations	Secondary and tertiary machining operations	Secondary machining operations	No or minimal post operation
Tools	Different types of cutting and finishing tools	Different types of cutting & finishing tools	No tools required
CAD data	CAD model not required	CAD data required	CAD data (STL format) required
Risk factor/error	Very high risk factor	High risk factor	Lower risk factor
Intricate Features	Intricate features within the pattern can't be built	Forming Intricate features are limited	Intricate features are easily built
End product Operator	Single pattern at a time	Single pattern at a time	Possibility of multiple patterns
Nature of the product	Generally solid pattern	Solid & hollow pattern	Solid and hollow pattern

Research by [14] shows that the integration of rapid prototyping technology in the product lifecycle can reduce the time and cost significantly to 10-50%. As illustrated in Fig. 3, when rapid prototyping technology is integrated into the product life cycle, the assembling and function testing can be done simultaneously during manufacturing. This is due to the ability of RP technology (especially high-end FDM) to integrate multiple operations in manufacturing, which saves time and production cost.

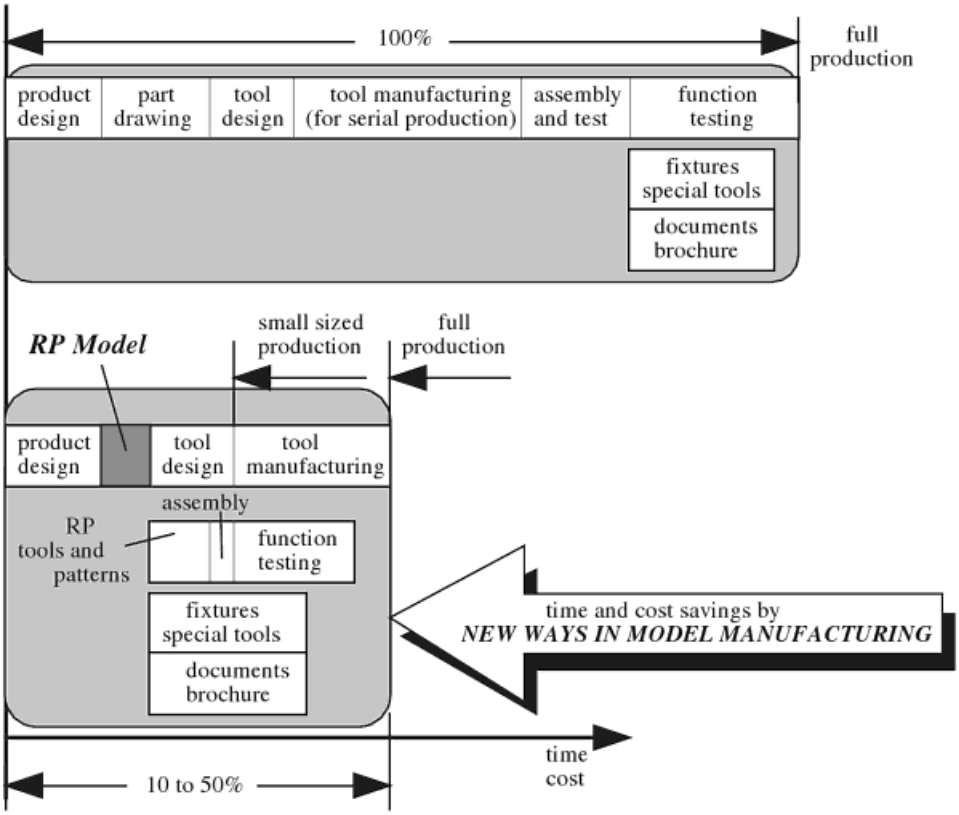


Figure 3: Results of integration of Rapid Prototyping technology [14]

Due to the advantages of rapid prototyping, the technology has been employed in many advanced ceramic industries, right from the conceptualization of ideas to realisation of processes [15]. Its application has been motivated by the advances in engineering ceramics where methods of creating complex shapes are limited [16].

Research by [17], [18] on 3D printing of ceramics for design concept modelling at the Centre for Fine Print Research, the University of the West of England confirms that rapid prototyping technology is viable tools for developing designs with complex shapes. Similarly, [19], designers at Denby pottery, stated that the modern techniques (RP) has made concept to manufacturing process much faster, compared with the traditional techniques (hand throwing, turning and hand modelling) earlier used.

In addition, an experimental research conducted by [20] to validate how digital and rapid prototyping can help in enhancing competitiveness in cottage ceramics industries (craft industries) revealed that rapid prototyping is viable for reducing development time. As illustrated in Fig. 4, rapid prototyping technology was able to reduce development time between 26-36%. Besides, the findings also show that the digital process enhances product quality, in terms of design quality.

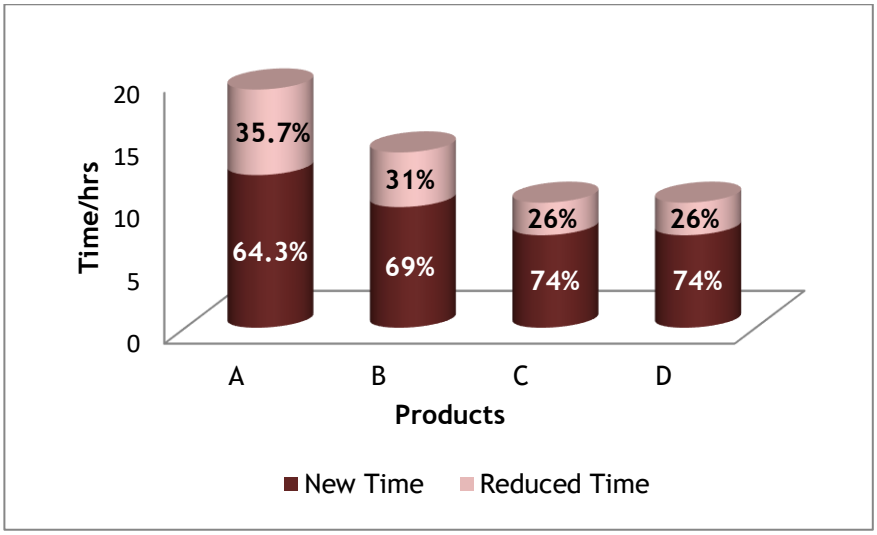


Figure 4: The percentage reduction in time by rapid technology [20]

Therefore, this dramatic timesaving technology allows manufacturers to bring products to market faster and more cheaply. Even though rapid technology has not been fully adopted in arts and crafts, but with the ability found in this technology, if fully harnessed, can bring the craftsmanship in ceramics craft enterprises into the modern world; where the artisan skills and contemporary technology can merge and fuse harmoniously to produce products that meet contemporary needs.

3. RESULT AND DISCUSSION

This paper seeks to explore on how the indigenous craft designs can be enhanced through cultural hybridization, where traditional and modern values are integrated. As earlier explained, the indigenous craft designs were viewed in four (4) contexts, which are: the authenticity (*origination*), the *conceptualization*, the *process of making* and the *final output product*.

Based on these contexts, the paper categorised the result and discussion into three (3) sub-groups, which are: people, process and product. This three will help to increase the diversity associated with the hybrid culture.

3.1 People: *The Creative Agents*

Many researchers such as [1]–[3], have indicated that one of the important factors that lead to unsuccessful craft enterprises is the obsolete designs and product. The reason while obsolete products predominate is because the craftsmen/artists solely determine the inherent meaning or function of art pieces without considering the needs of the end users.

Just as the modernist concept attributes the creator (artist, craftsman or designer) as the sole creative agent, so also the indigenous craftsmen solely determine what to produce and how to produce. However, the postmodernism overturned this idea and suggested that the users (individuals or local groups) are also an important creative agent in sustaining indigenous craft enterprises. They believed that if we are building things for the benefit of people (users), then the knowledge of the people (users) is required (users centred) just as the creative skills of the creator is needed.

Thus, the creative agents needed in craft enterprises should be both the creators and the users. The creators (craftsmen, artists or designers) are needed to *observe* potential users to identify the needs they seek and understand fully their relationship with objects. They

need to *think* of product ideas that meet those needs; and finally, adopt, innovate and manoeuvre techniques to create the product.

The users, on the other hand, are brought into the process to participate in testing the performance of product idea. According to [21], bringing in users to evaluate product idea at the early stage of product development will help to increase the resilience of relationships established between users and products. Besides, this will prevent craftsmen from wasting time and resources in producing art pieces that do not meet users' expectation.

3.2 Process: *The creativity in the making*

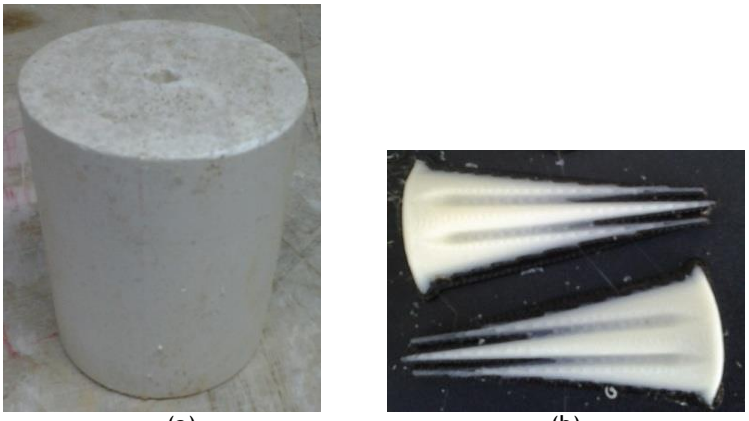
According to [22], up to 80% of the total cost is often committed in the concept development stage. The reason is because the decision made at this stage determines the final product performance. This makes the development process technically sophisticated, costly and time-consuming [23]. In ceramics production, the development process of the hand-carving and hand-turning prototype has been associated with these weaknesses.

However, with the digital revolution, product ideas can now be expressed all through the whole spectrum of the production process; from design initiation and decision-making through to technical design and subsequent link to the machinery [24].

To successfully embrace this modern technology (rapid prototyping) while maintaining a grasp on cultural identities and values in indigenous craft production, the modern technology needs to be employed not as a total replacement of conventional techniques but to complement the artisanal skills. That is, rapid prototyping can be employed to build parts that seem impossible or difficult to create using the conventional techniques.

For example, the research developed a prototype (working model) of a ceramic mug using hand turning (conventional technique) and rapid prototyping (Fig. 3). The tapered cylindrical part was hand-turned in POP (Fig. 4a), while the fins at the two sides were built using rapid prototyping technology (Fig. 4b). These parts were finally assembled and used as working model to generate the mould for mass production. Fig. 5 is the final ceramic mug, which is decorated with the indigenous motif.

Figure 3: Hybrid prototype of a ceramic mug



(a) (b)

Figure 4: The separated parts of the mug; (a) POP part; (b) Fins built with Rapid prototype

Figure 5: Ceramic mug decorated with indigenous motif

Interestingly, when the hybridised technique used was compared with modern technique, the findings show that the development cost for the hybrid technique is 40% lower than when only rapid prototyping is used, while both techniques recorded almost the same development time [25]. This shows that the craftsmanship in ceramics craft can be brought into the modern world, where both artisanal skill and contemporary technology will merge and fuse harmoniously.

As illustrated in Figure 6, the integration of craftsmanship skills and contemporary technology will help craftsmen to be both artisanal and innovative. This will enhance the development process and reshape the craft enterprises from culture to economics, where product ideas (digital designs) can be easily shared with potential customers/users prior to production. According to [26], the simple act of sharing the idea with potential customers can become the engine of innovation and opportunity for collaboration. Moreover, this will also make them think outside the box and create products that meet users needs.

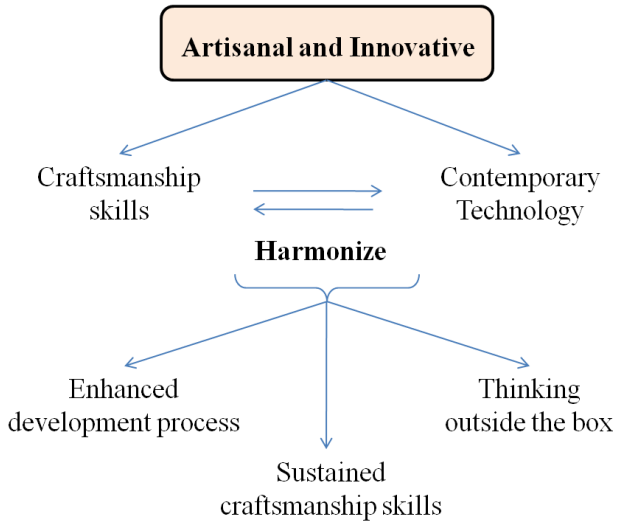


Figure 6: Harmonising contemporary technology & conventional technique [27]

3.3 Product: *The Creative Output of Culture*

Culture consists of a dynamic system made up of interacting parts, and one of the products of this interaction is heritage values, which results from the systemic interaction of culture with the environment [4]. Even though the cultural authenticity of many societies has been questioned due to globalisation: many believed that reproductive production is the only valid approach to preserving indigenous crafts and skills. This involves the continual production of historical heritage crafts in an authentic way, with all features and techniques preserved to a great extent.

However, since culture is a dynamic structure, people yearn for new things that integrate *tradition* and contemporaneity [28]. Therefore, the cultural differential paradigm argues that among and between cultures, there are lasting differences that are largely unaffected by globalisation or by multi or transcultural processes. Thus, preservation of indigenous crafts should involve identifying and keeping those values from traditions (cultural features) and developing or improving others to suit contemporary needs. According to [29], this hybrid concept creates contemporary values that communicate effectively with its ultimate users and make effective links with the society and history.

When cultural values are added, they create the core of product value [30], and on the other hand, the crafts can be used as a motivation to push cultural development forward. Thus, to encode cultural features in crafts, [30] developed a *Conceptual Cultural Design Model*, which focuses on how to extract the cultural feature from a cultural object and then transfer these features to a design (Fig. 7).

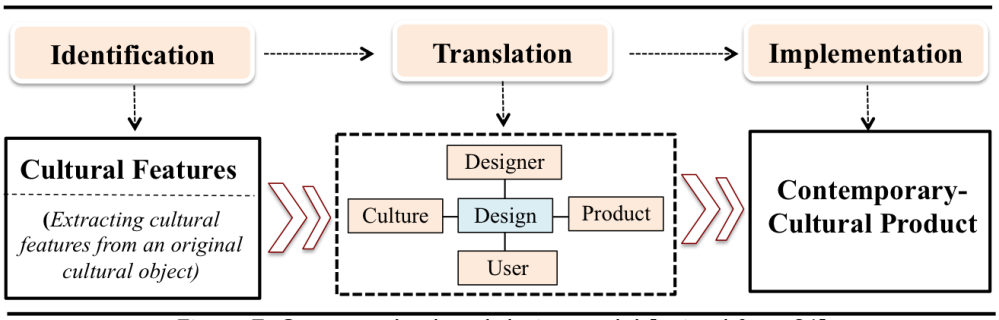


Figure 7: Conceptual cultural design model [coined from 36]

The model consists of three stages; the first is identification stage, which involves identifying and extracting cultural features from the original cultural objects (such as the texture, colour, patterns/motifs etc.). The second stage, translation, involves transforming the features into design elements; while in the third stage, implementation, designer combines the design knowledge gained on cultural objects with his/her sense of design to create contemporary cultural products.

The application of this model is a post-modernistic concept of sustaining cultural heritage values by transforming them into commodities that have significant contemporary values. Besides, it helps to identify how modern technology (such as rapid technology) can be appropriately employed without altering the cultural authenticity of the product. According to [31], [32], this approach will also create contemporary values that respects and preserves culture and history of the society that produced them.

4. CONCLUSION

This paper argued that the attempt to sustain indigenous crafts enterprises should go beyond reproductive production, which is a static cultural approach that discourages improvement of the products and process and limits craftsmen as the only creative agents in the development process. Instead, *the paper proposed a dynamic concept called cultural hybridity that blurs the lines between the traditional and contemporary values*.

As summarised in the illustration in Figure 8, *the paper argued that crafts should be user centred rather than a mere expression of craftsmen rational thoughts*. Thus, both craftsmen and the users are needed as the creative agents in the hybrid process, while the artisanal skills and modern technology are to be combined as a creative process. Besides, the output products (crafts) are not meant to be reducible to either tradition or contemporary culture, but a creative binding (hybrid) that enables the appreciation of both sides of the equation and their union. This mixture or conjunction, according to [33], [34], is ironical because it can say two different things at the same time.

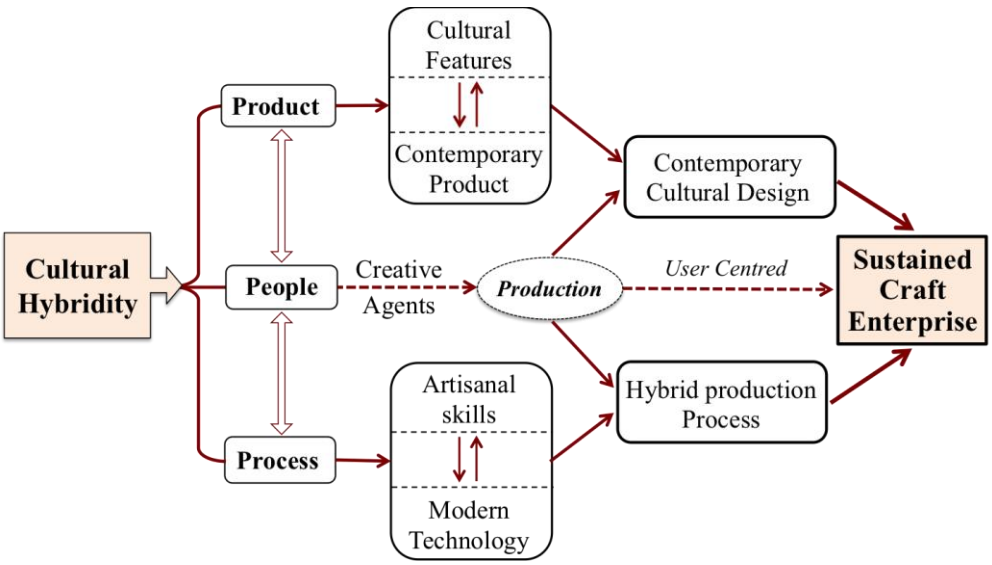


Figure 8: Cultural hybridity approach to sustain craft enterprise

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