

## Characteristics of selected product design theories and their use in textile product innovation

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### Abstract

A desk review investigated the role of product design and development theories in textile product innovation. The study specifically assessed the literature on Product Design & Development (PDD), Textile Product Design (TPD), Textile Product Innovation (TPI), and Micro and Small Enterprise (MSE) design practice. The study was guided by product design and product development theories that included: The Componential Theory of Creativity (CToC), Concept-Knowledge Theory, The design square model of the C-K theory, The Investment Theory of Creativity (ITC), Self-Determination Theory (SDT), and Theory of Creative Destruction (ToCD). The research assumption was that the success of a new product development (NPD) process strongly depends on the deep understanding of market needs. The two lead research questions were: Do the product design theories lay emphasis on the market factor? What common factors are found among the theories? This study will be vital to make policy recommendations for local textile manufacturers' assistance on product design, diversification, and value addition for their products to compete competitively with products from other countries.

**Keywords:** Product Design Theories; Product Design & Development; Textile Product Design; Textile Product Innovation; Creativity; Innovation

## **1.0 INTRODUCTION**

Micro and small enterprises (MSEs) face a considerable measure of difficulties while attempting to get products to markets. Some of these difficulties incorporate issues relating to internal and external environment, to include market related issues, among other problems of organizational and environmental concern (Khedhaouria, Gurau & Torres, 2015). Enterprises need to be strategic to be competitive. This will include a focus on product innovation. Few studies have examined the roles that product design strategies and theories play in increasing the competitiveness of textile enterprises. And despite the interest in small enterprises, the knowledge base about how MSEs actually undertake innovative activities is scarce. This presents a knowledge gap that needs to be bridged in various ways including examining the role of textile product design and development theories enable innovation and competitiveness.

### **1.2 Rationale**

The textiles and apparel industry occupy a prominent economic position, in terms of trade, employment and foreign investment, in the economic development of many countries. However, the combination of international pressures arising from globalization as well as international commercial policies, including tariff and nontariff barrier reduction on the one hand, and national policies on the other, have brought enormous challenges to the contribution of the industry to these countries economic development. To the local firms it is vital to know how to discern opportunities so as to remain relevant in local textile industry and international market. This study will be a source of reference to other future researchers who may have an interest in researching on a similar topic in other industries or to further establish more findings in this area

### **1.3 Scope and Limitation**

The study will cover variables that include Product Design & Development (PDD, Textiles and Textile Product Design (TPD), Innovation and Textile Product Innovation (TPI) and Micro and Small Enterprise (MSE). The study will also be limited to the Componential Theory of Creativity (CToC), Concept-Knowledge Theory of Innovation(C-K Theory), were selected to explain the research study's and are deemed appropriate because they explain the design perspective of the New Product Development (NPD) and TPD process in an MSE.

## **2.0 REVIEW OF LITERATURE**

The survival and growth of the textile industry, is heavily reliant on the process of innovation and technology that meets the industry's evolving and ever-changing needs and trends (Suharyanti, Subagyo, Masruroh & Bastian, 2017). Product development strategies and processes of textile companies differ as much as the number of companies in this field, as do the complexities and simplifications; value systems and aspirations; market share and penetration of each company (Sripirabaa & Maheswari, 2015). New technology perceived from a commercial opportunity typically serve as the catalyst for innovation. As a result, new goods are widely classified as either being driven by the market (market-pull) or by technology (technology-push) (Sripirabaa & Maheswari, 2015). Assoreira Almendra, Sattayaraksa & Boon-itt (2016) reported that there is a lack of a systematic approach in

design, pointing out that there are inconsistent final solutions for challenges of overall quality, productivity, and strategic capability in enterprise management and product marketing.

Some key points about innovation include that; Innovation is critical to companies' long-term growth and renewal. It is a complex construct that overlaps with a few other prevalent concepts such as technology, and creativity, and change. Innovation is generally driven by creativity, empowerment, and change of organizational culture. Innovation is significant at all stages of competition and creates wealth in the business environment for companies. To succeed in offering innovative products and services, businesses must implement innovation culture into their processes. If businesses want to succeed and produce innovative products, they must establish, nurture, and support an innovation culture (Wadho & Chaudhry, 2016).

*"Creativity is the stage of generating ideas, while innovation is the subsequent implementation of these into new procedures, practices or products"* (Anderson, Potocnik & Zhou, 2014).

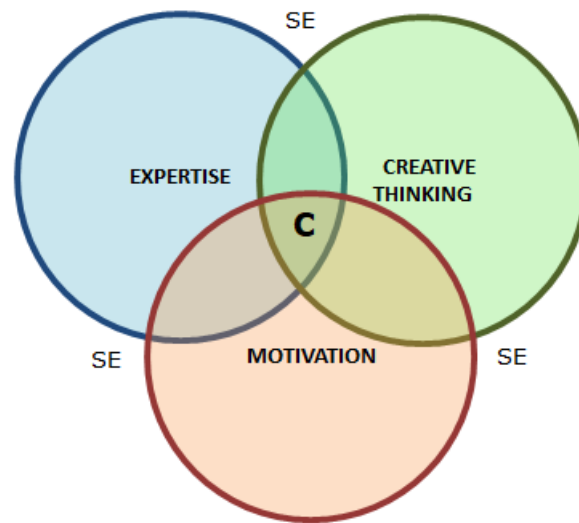
## **2.1 Product Design & Development (PDD) Theories.**

Product design and development is a critical area in product innovation and manufacture, this necessitates enterprises that want to be ahead of their competition to incorporate and give priority to PDD in their production planning. The planning can rely on one or more product design theories like the ones selected in this research namely; The Componential Theory of Creativity (CToC), Concept-Knowledge Theory of Innovation(C-K Theory), the Investment Theory of Creativity (ITC), Self-Determination Theory (SDT), and the Theory of Creative Destruction (ToCD).

### **2.1.1 The Componential Theory of Creativity (CToC)**

The Componential Theory of Creativity (CToC) is a well-known paradigm that includes elements inherent in both individual and group creativity and explains how the individual designer and the group can be influenced by enterprise aspects crucial for innovation. The CToC was founded by Teresa Amabile in 1983 to serve as a realistic illustration of the psychological requirements for producing creative work (Amabile, 2012) According to the CToC, investigating both intrinsic and external factors is necessary to boost enterprise innovation. Four factors are required to be taken into account, according to the CToC, three of which are related to the individual or creative team and one of which is external to the individual. The components are illustrated in figure 2.1. The CToC stipulates that "creativity should be highest when an intrinsically motivated person with high domain expertise and high skill in creative thinking works in an environment high in support for creativity" (Amabile 2012, p. 3).

## COMPONENT MODEL OF CREATIVITY



### Legend

**EXPERTISE:** Refers to a skill where knowledge, technological, procedural, and intellectual ability are applied.

**CREATIVE THINKING:** Refers to using the mind in a flexible and imaginative way to solve a challenge.

**MOTIVATION:** Refers to an inner passion to solve the problem at hand. (Intrinsic Motivation)

**C= CREATIVITY:** Refers to process of individual creativity and organizational innovation.

**SE= SOCIAL ENVIRONMENT:** Refers to the work environment intervening factors in the creative process (Extrinsic motivators).

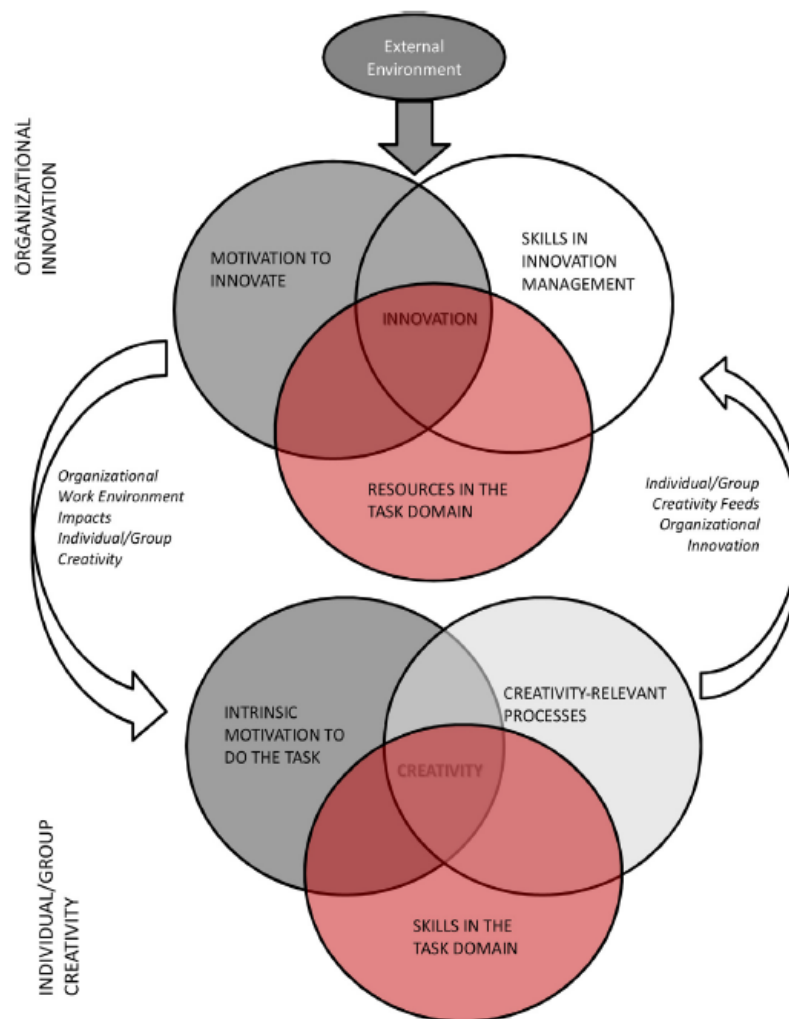
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### **Figure 2.1: Component Model of Creativity**

Source: Amabile (1998)

The intrinsic motivation concept has received the greatest criticism of any CToC premise. However, the vast majority of studies examining the intrinsic motivation principle have confirmed the relationship to creativity that has been made (Amabile, 2012). The componential model is the earliest theory of creativity and innovation in organisations. It is also a widely used theory to describe both the process of individual creativity and the process of organisational innovation, as well as the ways in which the two are connected through mutual influence (Amabile & Pratt, 2016). To clarify the symbiotic relationship of the individual creativity aspect and the enterprise innovation in product design, the Amabile's component model of 1988 was further enhanced (Creativity and Innovation) as illustrated in Figure 2.2.

## COMPONENTS INFLUENCING INNOVATION AND CREATIVITY



**Figure 2.2: Interaction between Creativity and Innovation**

Source: Amabile & Pratt (2016)

The symbiotic relationship as illustrated is that individual/group/team creativity feeds the organizational/enterprise innovation; while organizational work environment also impacts individual/group/team creativity.

### 2.1.2 Concept-Knowledge Theory (C-K Theory)

According to Hatchuel, Masson, and Weil (2004), the C-K theory provides a formal basis for understanding existing design concepts as specific examples of a unified reasoning model, and it also places creative thinking and innovation at the centre point of the product design process. Hatchuel and Weil's (2003) 'Concept-Knowledge theory' (C-K theory) addresses two main spaces in the innovation process: the concept space (C) and the knowledge space (K).

“This model solves important problems that are not well treated by traditional theories: (a) It offers a clear and precise definition of design that is independent of any

domain or professional tradition; (b) It gives to design theory the same level of rigor and modelling that we find in decision theory or programming theory; (c) It offers a theory where creative thinking and innovation are not external phenomena, but the central core of the theory. The latter was hardly addressed in existing theories while Design is a process by which something unknown can intentionally emerge from what is already known" (Hatchuel, et al., 2004, pp. 1-4).

The C-K theory is thus a formal design theory that emphasises creativity as a key component of the process of creating new entities or variables. The theory depicts the relationship between spaces and how they improve the creative process while increasing the chances of incremental and radical innovation (Ruiz, 2009). A 'design square' diagram depicts the interaction between the operators; these operators record the versatility of the innovation process as well as the range of design scenarios. It models the design dynamics as a joint expansion of a space of concepts (C) and a space of knowledge (K), employing four operators ( $C \rightarrow K$ ), ( $K \rightarrow C$ ), ( $C \rightarrow C$ ), ( $K \rightarrow K$ ). Shai, Reich, Hatchuel, and Subrahmanian (2012) added to the design square narrative that concepts and knowledge interact for effective creativity, with concepts relying on aspects from the nominal world and knowledge relying on the logical/factual world (Illustrated in figure 2.3).

### THE DESIGN SQUARE MODEL OF THE C-K THEORY

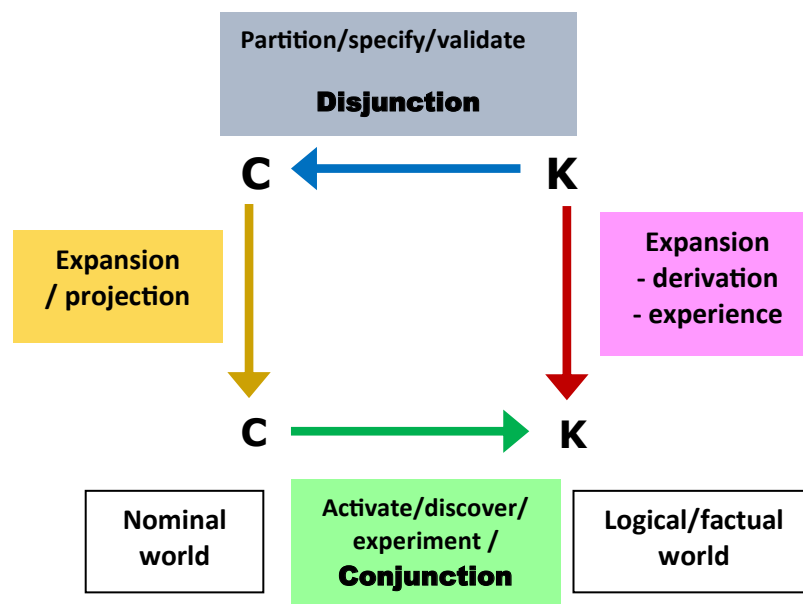


Figure 2.3: The design square model of the C-K theory  
Source: Shai, Reich, Hatchuel, & Subrahmanian, 2012

The external operators are ( $C \rightarrow K$ ) and ( $K \rightarrow C$ ) and internal operators are ( $C \rightarrow C$ ) and ( $K \rightarrow K$ ). The ( $C \rightarrow K$ ) operator seeks to broaden a company's current available knowledge (K) through concepts (C) formed in the organization's external environment. Bringing together (conjunction) and activating existing concepts originating outside the company to generate new knowledge for product design is the operation. The ( $K \rightarrow C$ ) operator expands a firm's concept space (C) by bringing in external knowledge (k) elements. The operation includes knowledge disjunction and validation to be applied to concept development. If not done carefully ( $K \rightarrow C$ ), it may result in 'imitation' since it may involve the use of previously proven market/product concepts (designs); in other words, fixation on current product ideas.

“C-K theory explains the fixation effect as arising from both a limitation of C and K expansions. Interestingly, the theory predicts that people tend to generate ideas that are most accessible in memory. This activation of common knowledge could lead to fixation effects” \_ Agogué, et al. (2013. p. 3)

The internal operator ( $C \rightarrow C$ ), implies the partitioning or inclusion of existing internal concepts in the development of new enterprise design concepts. This could be a common approach for companies to develop new and distinct designs from internal concepts. The ( $K \rightarrow K$ ) operator enables the knowledge space to self-expand, here Internal enterprise knowledge is created through deduction and experimentation with existing knowledge. The C-space is the map of all possibilities, according to France (2017), while the K-space is the knowledge library. In other words, the C-space is a place where you can conceive and discover different concepts, whereas the K-space is a database of knowledge that you can use or require to envision or design new concepts. Bessant (2003), states that knowledge stimulates innovation and is at the heart of the 'core competency' argument, which asserts that businesses must grow and manage their knowledge resources. According to Bessant (2003), enterprises that create and apply their knowledge and expertise have a better chance of establishing and maintaining a competitive advantage in their industry. This suggests that textile MSEs must update their knowledge and skills in order to add value to existing products and develop new ones.

### **2.1.3 The Investment Theory of Creativity (ITC)**

According to the investment theory of creativity (ITC), creative thinkers are like good investors who buy low and sell high (Sternberg and Williams 2012). Sternberg and Williams argue that creativity is not limited to a select few, but that anyone can be creative if they are willing to put in the necessary time and effort. The culture of imitation and low product differentiation, evident in the Textile sector may be partially a reflection of enterprises avoiding risks and failure.

According to the ITC, when creative ideas are proposed in an organisation, they are frequently viewed as strange, valueless, and even unwise, and are summarily rejected, with the individual introducing them viewed with suspicion, and possibly even disdain and derision. Some stakeholders do not reject creative ideas maliciously or wilfully; rather, they do not realise, and frequently do not want to realise, that the proposed idea represents a valid and superior way of thinking. They generally consider opposition to the status quo as annoying, offensive, and reason enough to dismiss novel ideas (Sternberg and Williams 2012). In order to avoid imitation and low product differentiation, businesses must embrace R&D and use sound product design approaches.

### **2.1.4 Self-Determination Theory (SDT)**

Edward Deci and Richard M. Ryan introduced the Self-Determination Theory (SDT), which proclaims that designers have an external and internal perceived locus of causality in the proposed study (PLoC). Internal PLoC is associated with intrinsic motivation, whereas external PLoC is associated with extrinsic motivation (Changing Minds, 2012). The relative strength of autonomy is central to SDT, and both intrinsic and extrinsic motivations are linked to workplace performance, satisfaction, trust, and well-being (Gagne & Deci, 2005).

SDT identifies three innate needs that, if satisfied, allow optimal function and growth; Competence, Relatedness and Autonomy (Gagne, 2014).

Imitation culture and low product differentiation may result from a lack of creativity, a case of low self-esteem, and a lack of intrinsic motivation. The enterprise should strike a balance between internal and external PLOC. The intrinsic motivation is represented by the internal PLOC, while the extrinsic motivation is represented by the external PLOC. Product design choices in the internal PLOC are primarily determined by one's own preferences, values, and interests, whereas product design choices in the external PLOC are influenced by some external event, person, or force. Because competitors are exposed to the same external PLOC, relying too heavily on extrinsic motivation increases the likelihood of similar product designs. However, in Product Design strategy, both intrinsic and extrinsic motivation factors should be considered. Core Competence, Customer and competitor analysis are important considerations not only in Business Strategy but also in Product Design Strategy. Only by combining these three Cs into a strategic triangle can a sustainable competitive advantage be achieved. The SDT identifies the following three considerations:

Competence: succeeding in what you do.

Relatedness: connecting with others.

Autonomy: being in control of your life.

Textile MSMEs must be competent in their product design and innovation effort, which entails embracing knowledge, technology, and skill development strategies. Networking, alliances, subcontracting, and collaborative strategies are all examples of relatedness. Autonomy suggests embracing unique and innovative branding strategies. The theory explains how individuals behave and perform in a given environment. It has been used by various researchers to study individuals in a variety of settings (Hill, 2011). At the heart of product design is the Designer, who is influenced by both personal and external factors. It is also known as the Perceived Locus of Causality (PLOC) (Changing Minds, 2012). Thus, the PLoC is linked to both intrinsic and extrinsic motivation. The distinctions between the two types of motivations have contributed knowledge to both developmental and educational practise (Deci & Ryan 2000). SDT is made up of two sub theories; the Cognitive Evaluation Theory (CET), and the Organismic Integration Theory (OIT) as indicated in figure 2.4

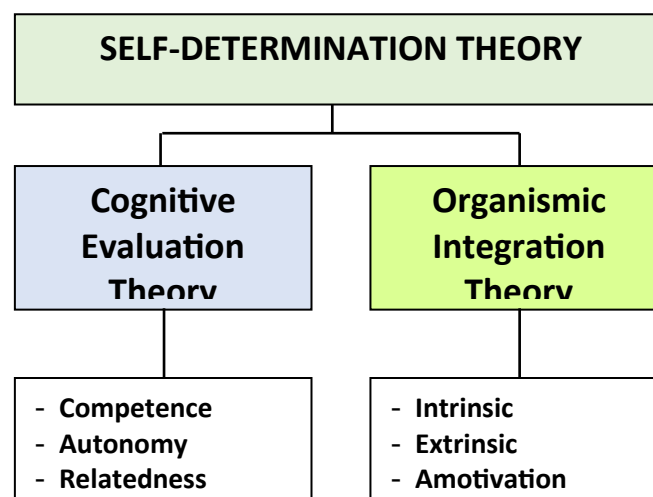


Figure 2.4: Self-Determination Theory



Source: Jones (2014)

#### 2.1.4.1 The Cognitive Evaluation Theory (CET)

CET explains how Intrinsic Motivation is influenced by three psychological needs

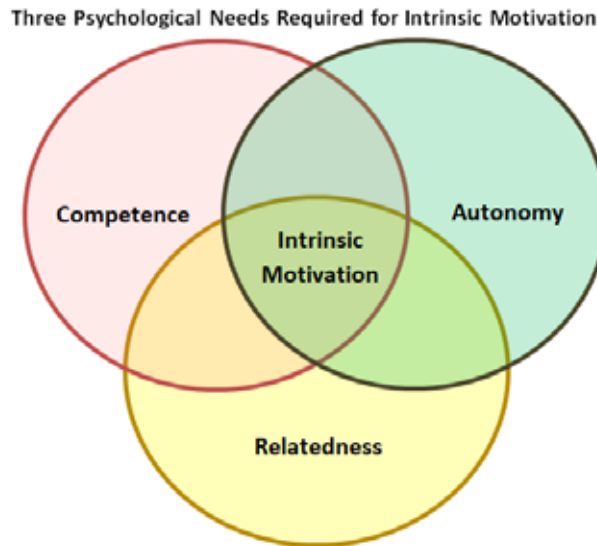
CET states that people (Designers) have a need to perceive that:

They are competent. Good in what they do

They have autonomy. Free to make a choice and have control over their actions.

They have relatedness. Connection to others through positive relationships.

(Deci & Ryan, 2000; Gagne, 2014; Jones, 2014)



**Figure 2.5: Three Psychological Needs Required for Intrinsic Motivation**

Source: Jones (2014)

#### 2.1.4.2 The Organismic Integration Theory (OIT)

The difference between Intrinsic Motivation, Extrinsic Motivation, and Amotivation is explained by Organismic Integration Theory (OIT) (Deci & Ryan 2000; Jones 2014). OIT focuses on the relative strength of autonomy; research indicates that intrinsic and extrinsic motivations are both related to workplace performance, satisfaction, trust, and well-being (Gagne & Deci, 2005). Intrinsic motivation is doing something for its inherent satisfaction while 'Extrinsic' is because of some consequence. Imitation culture and low product differentiation may result from a lack of creativity, a case of low self-esteem, and a lack of intrinsic motivation. Product design strategies are primarily determined by the (self or enterprise) own preferences, values, and interests, which are influenced by some external event, person, or force.

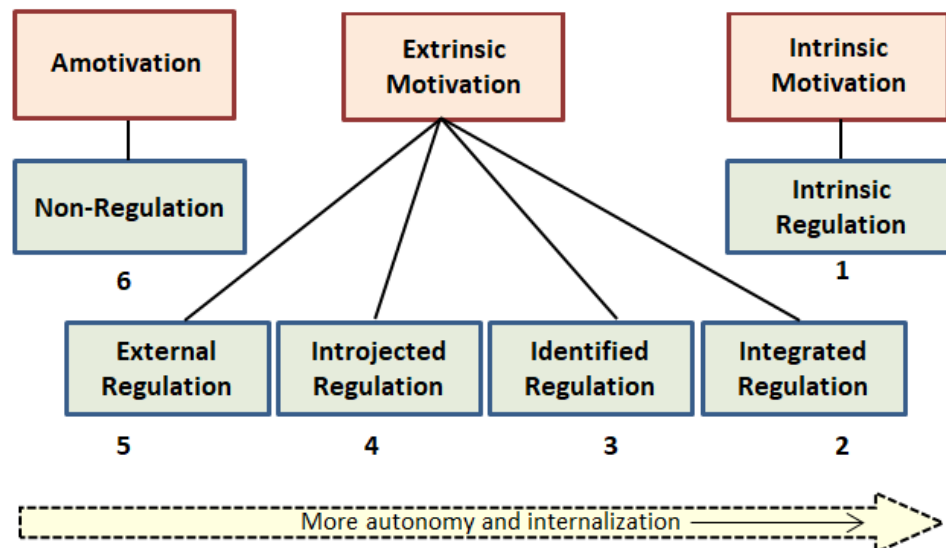


Figure 2.6: The Organismic Integration Theory  
Source: Jones (2014)

The following statements from the worker (Designer) will tell what kind of motivation they experience.

1. "I work hard because I enjoy my job" = Intrinsic Regulation.
2. "I work hard because I am a good employee" = Integrated Regulation
3. "I work hard because my job is a crucial part of the organization" = Identified Regulation
4. "I work hard because management and co-workers expect me to do a good job" = Introjected Regulation
5. "I work hard to get my annual bonus" = External Regulation
6. "I don't care" Just going through the actions = Amotivation

### 2.1.5 Theory of Creative Destruction (ToCD)

The theory put forward by Joseph Schumpeter states that 'old ways of doing things are destroyed and replaced by the new' (McCraw, 2010). The ToCD recognizes that designs lose their appeal after sometime; therefore Textile enterprises need to introduce new products to sustain their current customers and attract new ones. In the business environment when an innovating company makes profits from its product, they will be copied or imitated by competitors, leading to the inability of the innovators (first movers) to sustain profits (competitive advantage) (Pfarrer, 2015). To maintain profitability and avoid the perpetual gale of Creative Destruction, the successful firm (first mover) must constantly innovate.

## 3.0 DISCUSSION OF RESEARCH FINDINGS

The findings show that innovation capability and absorptive capacity positively influenced the performance of textile enterprises. According to the literature reviewed on the Componential Theory of Creativity, creativity should be at its peak when a motivated person with strong domain expertise as well as high skill in creative thinking works in an environment supportive of creativity.

Successful product innovation in a for-profit enterprise results in products that can be produced and sold profitably, but profitability is often difficult to assess quickly and directly. Product quality, product cost, development time, development cost, and development capability are five more specific dimensions commonly used to assess the performance of a product development effort, all of which ultimately relate to profit. For the invention of textile concepts and the innovation of textile products, a design-driven approach is preferable. Although one fully developed project may not be enough to confirm the reliability of the design-driven innovation model within the textile industry, the elaboration of theories inspired by this case opens up new avenues for future development in textile design and research. The findings revealed that the success of a textile product innovation is heavily reliant on a thorough understanding of market forces as indicated in figure 3.1.

**Table 3.1 Product Design Theory Characteristics**

|    | <b>Product Design Theory</b>             | <b>Characteristic</b>   | <b>The market factor in Innovation</b>   |
|----|--|---|--|
| 1. | Componential Theory of Creativity (CToC) | Creativity, Critical Thinking, Motivation, Expertise, Social environment (Includes market factors, Customers, Suppliers and Competitors). Internal and external environment considered. | Design concepts are inspired by market forces. Products created for customers and considering prevailing market trends |
| 2. | 'Concept-Knowledge theory' (C-K theory)  | Design conceptualisation _ Both new and derivatives. Knowledge use _ Both new and derivatives. . Internal and external environment considered.  | Concepts and knowledge from market environment are used to create products for the market                              |
| 3. | Investment theory of creativity (ITC)    | Freedom, time, and passion to create and innovate. Internal and external environment considered.  | The main resources and inspirations originate from the market environment  |

|    |  |   |   |
|----|--|---|---|
| 4. | Self-Determination Theory (SDT)<br><br><u>Sub-theories</u><br>- Cognitive Evaluation Theory (CET)<br><br>- Organismic Integration Theory (OIT) | Competence, Relatedness, Autonomy. Intrinsic and extrinsic motivation factors considered. | Competence which is an attribute of the sub-theory Cognitive Evaluation Theory (CET) will be guided by the available and prevailing technologies and trends in the market.  |
| 5. | Theory of Creative Destruction (ToCD)  | Sustainability of innovation require a firm's response to copying and Imitation           | An enterprise should anticipate that a product with good performance in the market will be copied and imitated. Also products get out-dated and will need replacement. Therefore firms need to strategize for new innovation and product diversification. |

#### 4.0 CONCLUSION AND RECOMMENDATION

The selected product design theories revealed common factors enterprises should consider. These included both firm internal and external environmental factors, with the main attributes being knowledge, skill, motivation, and market factors.

There is a need to incorporate the element of product design theory into the new product design characteristics. It broadens the knowledge of product designers and users as a strategy for increasing the efficiency of generating new product ideas and improving product quality and market success. Increased government business support services (GBSS) should be embraced as a policy tool for improving the performance of innovations by textile enterprises. Kenya has given priority to innovation by establishing innovation policies geared towards economic development. This is evident in a number of government policy pronouncements. For example, according to Ndemo (2015), Kenya's first innovation policy was launched in 2006 with the implementation of the Vision 2030 initiative. The vision recognises the critical role played by research and development (R&D) and innovation in accelerating economic development. In 2009, a comprehensive policy on Science, Technology, Innovation, Policy and Strategy (STIPS) was developed. In 2012, the Science, Technology, and Innovation (ST&I) Act was enacted. The Kenya National Innovation Agency (KENIA), set up for the purpose of developing and managing the Kenya

National Innovation System, was established under the ST&I Act No. 28 of 2013 (Kenia, 2018).

Other recommendations are that enterprises create in-house strategies that enhance textile product innovation by nurturing practical design strategies guided by appropriate theory. Another recommendation is that the government follow up the implementation of the Kenia strategic objectives on innovation. These include: creating awareness and disseminating information on innovation, To strengthen and coordinate the innovation system through partnerships and linkages, to harness innovation for the transformation of the economy, and To mobilise financial resources to support innovation processes (Kenia, 2018).

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