Retrospective Analysis of Ghanaian Traditional Weaving Industry through the Lens of Tom Kelley's Design Framework

Abstract

Tom Kelley's design framework is a popular and versatile design thinking model employed by various industries in solving major design problems and challenges. The Ghanaian weaving industry as one of the creative industries is believed to be facing challenges with innovation and sustainability in modern business. This hypothesis triggered the need to undertake an analytical study of the industry using Tom Kelley's design framework (DVF design thinking model) to assess its waste reduction, value addition, product-market speed and profit maximisation. A desk research was conducted to gather literature from credible sources to identify gaps in the industry and to recommend feasible and viable solutions to improve the industry. The results reveal that the three dimensions of the model can be dependent or independently applied in the industry. Furthermore, it unearthed the strong interrelation between feasibility and viability as the major pointers in solving design problems in the Ghanaian weaving industry where research and technological advancement are needed. From the study, it is suggested the industry should embrace technology and innovations in the production line in order to sustain the Ghanaian weaving industry in modern business landscape.

Keywords: *Feasibility, Viability, Desirability, Design Thinking, Innovation*

Introduction

Earlier, it was revealed that corporate environments are beginning to pay more attention to design thinking (Dunne and Martin, 2006). This is because many well-known organisations have made a commitment to becoming design leaders, demonstrating how important product and service design is to company competitiveness. Subsequently, Shute and Becker (2010) opines that being

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

successful in today's increasingly technology and competitive business environment necessitates the development and use of new skills, one of which is design thinking.

Design thinking promotes innovation. To survive and compete in today's fast changing climate, businesses must innovate. Cross-functional teams collaborate in design thinking to identify user demands and develop solutions to meet those needs. In addition, the design thinking approach aids in the discovery of innovative solutions (Interaction Design Foundation – IxDF, 2016).

Furthermore, Micheli et al. (2019) propel that design thinking encompasses various methodologies that prioritize user needs and iterative testing. Other methods include prototyping and user feedback loops. Due to its innovative approach to innovation and problem-solving, design thinking has garnered significant interest from both academics and practitioners.

As a human-centred approach to innovation, Cuofano (2024) explains that design thinking incorporates the needs of people, the possibilities of technology, and the needs of a business into a balanced approach. To solve critical problems, desirability, feasibility, and viability should all be balanced.

Interestingly, Tom Kelley, a prominent figure in the field of design thinking, introduced a powerful framework that illustrates the intersection of three critical dimensions: desirability, feasibility, and viability. This Venn diagram serves as a visual tool to guide innovation and problem-solving processes, particularly in creative industries. Yurii (2022) explains that this Venn diagram facilitate brainstorming by allowing teams to explore the overlap between user needs, technological capabilities, and business goals, leading to more creative solutions.

Significantly, it is identified as iterative in its working approach that yields the required solution to any challenge identified or undertaken (Orton, 2017). It is propelled that the synergy nature of this design thinking model gives innovative solutions to identified problems or design challenges. It is known to be one of the major design thinking and innovation models employed in various cooperate and business entities.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

In support, the intersection of these three dimensions is crucial for successful innovation. As Rife et al. (2021) notes, when organizations find the sweet spot where desirability, feasibility, and viability overlap, they are more likely to create products that resonate with consumers while being practical and financially sustainable. This framework not only aids in product development but also fosters a culture of collaboration and creativity within teams, encouraging diverse perspectives to enhance the innovation process.

The traditional weaving industry in Ghana, particularly known for its production of Kente, Kete, and Smock (Fugu) fabrics, is a significant cultural and economic venture (Frimpong and Asinyo 2013; Asinyo et al., 2021). This industry is deeply rooted in the history and traditions of various Ghanaian communities, including those in the Volta, Ashanti, and Northern regions. The weaving techniques, materials, and marketing strategies may vary across these regions, reflecting the unique cultural heritage and socio-economic contributions of the craft (Asinyo et al., 2021; Afriyie et al., 2021).

However, the Ghanaian weaving industry is not just an artistic endeavour; it is a vital component of the nation's cultural identity and economic landscape. Traditional woven fabrics such as Kente, Kete and Fugu (Smock) are deeply embedded in social events and ceremonies, making them significant to both local communities and the global market (Ayesu et al., 2021). As globalization reshapes consumer preferences and production practices, understanding the dynamics of this industry has become increasingly relevant.

Despite the rich heritage and prospects associated with Ghanaian weaving industry, many studies have focused on individual aspects of the weaving process, materials, looms and accessories or market dynamics, failing to consider how these factors interact to create design and product innovation. For instance, studies by Afriyie et al. (2021) highlight the different use of varied materials and techniques stating that Asante and Ewe weavers commonly use synthetic yarns, while Daboya weavers use both synthetic and indigo-dyed cotton yarns. Subsequently, Asinyo et al. (2021) unearth that the type of loom and the number of heald shafts influence the complexity of weaves, with variations observed in Agotime-Kpetoe, Agbozume, and Bonwire. Furthermore,

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Boadi et al. (2023) reveal that changes in the environment, politics, formal education, and technology have influenced the production techniques, tools, and materials used in traditional weaving.

Unfortunately, these challenges persist because the Ghanaian weaving industry employs production methods, tools, and equipment that hinder the industry from fully realising its potential in a competitive marketplace. Asinyo et al. (2021) recommended that there is a need for weavers to embrace new technology to improve production levels and increase revenue.

Furthermore, traditional weavers struggle with access to modern tools, and technology which limits their productivity. Traditional weavers employ obsolete production methods which affects product value, and efficiency in market distribution. King et al. (2024) reveal in their findings that the main factors influencing Kente weaving were the low supply and demand for the product, the data and motivation management system, the absence of export promotion, and outmoded manufacturing methods.

Even though these studies sought to enlighten the various practices and production methods in the Ghanaian weaving industry, there is lack of design thinking and innovation process in the Ghanaian weaving industry which seeks to analyse the intersection between production (feasibility), market (viability), and consumer (desirability) in the sustenance and advancement of the industry in the competitive business market. The lack of studies on the interconnections of desirability, feasibility, and viability in the industry has resulted in missed opportunities for design and product innovation, leading to stagnant practices in the industry.

However, known to be one of the major design thinking and innovation models employed in the cooperate world, this study aims to analyse some challenges faced by the Ghanaian weaving industry through Tom Kelley's design framework to identify actionable design thinking and innovative insights to improve the competitiveness and advancement of the industry in the business landscape.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Additionally, the findings from this research will contribute to a deeper understanding of how to enhance the cultural and economic viability of traditional weaving, ultimately empowering artisans and promoting sustainable practices within the industry. Finally, this study seeks to illuminate pathways for business revitalization, ensuring that Ghana's rich weaving heritage continues to thrive in the modern world.

Literature Review

Viability, feasibility, and desirability are three key considerations that often intersect and influence the success of a project, product, or initiative. These concepts are commonly associated with design thinking and are crucial for creating innovative and sustainable solutions. The following paragraphs discuss various literature on viability, feasibility, and desirability according to authorities and writers.

The Various Facets of Tom Kelley's Venn Diagram in Design Thinking

In design thinking, the quest for innovative solutions often hinges on the harmonious integration of three critical dimensions: desirability, feasibility, and viability. As a model in design and innovation field, this diagram encapsulates these dimensions, providing a visual framework that aids in navigating complexities of the design process.

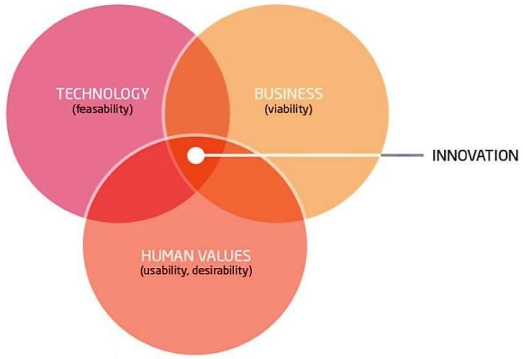

Figure 1: Tom Kelley's Design Framework

(Image Source: Inder and Reay, 2014)

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Chasanidou et al. (2014) explains that the design thinking process is regarded as a system of overlapping spaces, in which viability refers to the business perspective of design thinking, desirability reflects the user's perspective, and feasibility encompasses the technology perspective.

Research indicates that the foundation of each action taken by a design thinker is an effort to comprehend people better. People (as desirability), location (as business viability), and process (as feasibility) are the three main components that design thinkers utilize to make sure that this cooperation benefits the team members and yields outcomes in a reasonable amount of time (Gekeler, 2019).

In design thinking, feasibility, desirability, and viability are critical dimensions that guide innovation processes. Feasibility is the technical evaluation of a project, assessing its feasibility by evaluating the resources, technology, and skills needed to bring an idea to life (Eisert, 2014), desirability is a human-centric approach that prioritizes understanding user experiences and preferences to create products that resonate with target audiences and meet their needs and wants (Plattner and Zeier, 2012), and viability is the economic and strategic aspect of assessing the financial sustainability and alignment of a solution with business goals, ensuring its economic soundness (Vekinis, 2023).

It is emphasized that the terms "desirability," "feasibility," and "viability" relate to the degree to which a product satisfies consumers' requirements and wants, is technically achievable to produce, and is financially sustainable respectively in the business market (O'Donoghue, 2023).

It may be concluded that giving user requirements priority via desirability guarantees that solutions emotionally appeal to users and promotes empathy. Meanwhile, feasibility emphasizes the relevance of technological skills in ensuring that ideas are practically realized. Finally, viability highlights the need of integrating innovations with corporate goals to ensure financial sustainability. As design thinking evolves, Tom Kelley's Venn diagram stays relevant. It serves as a reminder that great design is more than just aesthetics or utility; it is about producing value that fulfils human needs while being feasible and sustainable within the industry.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

The Synergies Existing Between Viability, Feasibility and Desirability of Tom Kelley's Venn Diagram

Chasanidou et al. (2015) explains that this three-system overlapping spaces increase innovation within teams. It also serves as a way of incubating ideas and creating innovative solutions within teams when team collaboration and software limitations are balanced.

Hunter (2015) propels that the integration of desirability, feasibility and viability is a unique means to create a superior product. In adopting this framework, it helps to check tensions and provide the best solution to handle constraints and determine a good leverage for design challenges. This makes sure the end product meets both user needs and business objectives.

Desirability, feasibility and viability is described as the ideal innovation process, an idea according to Orton (2017) which originated from IDEO in the early '00s. It is enlightening that iteration is the wheel for building this trifecta of innovation. At each iteration, testing for these three and adjustments gives a strategic implementation to keep a design on track.

Connor (2019) opines that this framework of design thinking can refine strategies by identifying and investigating the most impactful user challenges or needs to reduce business risks and therefore improve the results. It helps to reduce costs, improve speed of new products on market as well as redefining existing products.

Kirsch (2020) explains that the fast rate at which many ideas can be attained out of this DVF model is outstanding. There are competing values and incentives at disposal for decision making. At the final stage, there is a holistic view of what to implement and from which operational direction to take.

In an interesting submission, Krithika et al. (2021) refers to these three key properties as three "lenses of innovation". In this synergy, it is asked that how can decisions be taken about the future if there is no financial clarity? What normally happens is a chain of gradual adjustments; a change to desirability leads to a tweak to the feasibility and worsen the viability. A change will lead to another until it is spiral inwardly towards the intersection of the three lenses to ascertain success.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Cristache (2021) is of the view that the value of balancing desirability, feasibility and viability is still incredibly significant to design, especially in the age of digital transformation. In almost all cases, "perfection" does not define success – rather, the best result lies at the intersection of these three facets of innovative thinking. In addition to being balanced, this approach is powerful because it is about designing with a purpose and increase the value of design solutions.

Mike (2021) submits that DVF framework is one of the most popular and versatile frameworks used to identify questions. It can be used on its own or in combination with other tools (e.g., Business Model Canvas, Lean Canvas, Value Proposition Canvas etc). It does not only provide a way to only explore a problem from a product perspective but can be used to explore the business model that underpins the product.

As a design thinking methodology, desirability, viability and feasibility is used to test ideas, concepts and hypotheses to determine the unique value proposition of a product (aka unique selling point) and whether it's worth pursuing. This synergy can be considered as a risk analysis methodology for ideas – a toolkit to locate that innovative sweet spot (Vinney, 2022).

O'Donoghue (2023) states that IDEO's desirability, viability and feasibility (DVF) framework is employed as a powerful tool to create product success in various industries. It is illumed that through this framework the knowledge of users' interest and needs about a product can be ascertained, while also being feasible to create potential long-term sustainability.

Gomez (2023) postulate that not only does this framework provides a more robust answer to original market opportunity hypothesis but it presents it much faster than following a sequential development path. In employing this approach, fully tested and approved product have been delivered into the market in less than 24 months from initial concept vision.

It is further revealed that Harjinthar (2023) for every new product, service, or company concept to succeed, the relationships between desirability, viability, and feasibility are essential. Businesses may develop goods and services that improve people's lives and are successful in the marketplace by comprehending these connections and working to strike a balance between them.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Desirability (user-centric design), viability (sustainable business) and feasibility (feasible implementation) together forms the three (3) pillars in design thinking throughout a project to de-risk innovation efforts. As a flexible method of creative problem solving, it assists in choosing the right methods along an innovation project (Dam, 2024).

The synergy formed at the junction of these dimensions fosters new solutions, eventually leading to goods and services that are not just functional but also meaningful and influential. The operability and usefulness of these major qualities of Tom Kelley's Venn diagram are evident in their synergetic approach, despite the fact that each may serve as an independent piece. However, such individual problem-solving effort reduces the validity of the design solutions discovered.

The Implementation of Tom Kelley's Venn Diagram in Ghanaian Industries

Poku and Ansah (2014) unravel a design thinking problem in Cocoa Processing Company in Ghana and recommended that the company acquire assistance of employees with background knowledge in design, business and technology to form a multidisciplinary team to help improve marketing activities in the organisation.

Akinny (2016) investigated in the desirability and feasibility of "Old People's Home" as a viable business in Ghana and unravel that the low patronage of this place is as a result of attitudes, cultural beliefs and economic hardship. However, its viability is achievable if people's perceptions are changed over time.

Deininger et al. (2019) examined how Ghanaian novice designers used prototypes (feasibility) throughout their design courses. It was evident that these designers used some critical prototyping best practice behaviours, while other behaviours were not fully utilised during the front-end phases of design.

Okai-Mensah et al. (2021) also recommended a Ghanaian production company should consider implementing design thinking process to create a culture of innovation, empower critical thinking, reduce waste, increase the speed to the market and improve profitability.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

A case study in a Ghanaian company unearth that, even though empathy (desirability) is practice in the initial stages of the company's design processes, its connection with viability and feasibility is not met which to an extend affects product innovation (Apau et al., 2022).

Padi et al. (2022) unearth that when feasibility and desirability of employees meet, there is a belief that the necessary skills and abilities are possessed which boost their level of intrapreneurship to undertake successful tasks. It was recommended that innovative ideas should be recognised among SME employees to boost production.

Evidently, the utilisation of Tom Kelley's Venn diagram in Ghanaian industries is really scarce and underachieved in relation to its novel idea of solving design problems and challenges. As far as literature is concerned, this design thinking model is underutilised within the Ghanaian creative industry where traditional weaving plays a prominent role in its establishment.

Methodology

Desk research is a procedure in which an individual reviews existing papers or data on a certain topic in order to obtain knowledge. The primary goal of a desk research is to discover relevant data sources, assess data quality, and identify gaps that may require more investigation. Desk research are frequently used to identify research topics and plan research studies (Ven 2023; Gell 2023). In support to this statement, Vijayamohan (2024) illumes that from the business perspective, desk research is a crucial procedure in gathering relevant data for analysis and recommendations.

It must be noted that due to resource constraints, a desk research was selected over primary data collection to leverage existing literature and data, allowing for a broader analysis of the Ghanaian weaving industry. Kiely (2024) highlights that desk research offers faster, cost-effective, and quicker insights into customer journeys, making it a valuable tool for businesses to make informed decisions.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

However, Owa (2023) also reveal that desk research has its limitations. It often relies on secondary data, which may not be up-to-date or entirely relevant to specific research questions. Additionally, it cannot provide the nuanced understanding that primary research methods, such as interviews or surveys, might offer in decisions.

Dwelling on its pros, desk research was conducted to ascertain secondary data from credible websites, articles, and conference papers focusing on the Ghanaian weaving industry. These sources were selected based on relevance, credibility, and publication date, ensuring a comprehensive overview of the current state of the weaving industry

The collected data was assessed for quality data, and identify design thinking and innovation gaps in the Ghanaian weaving industry. These identified gaps gave the platform for the study to analyse some challenges in the Ghanaian weaving industry using Tom Kelley's design framework as a design thinking solution tool.

The desk research methodology implemented in this study is exhibited in Figure 2.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

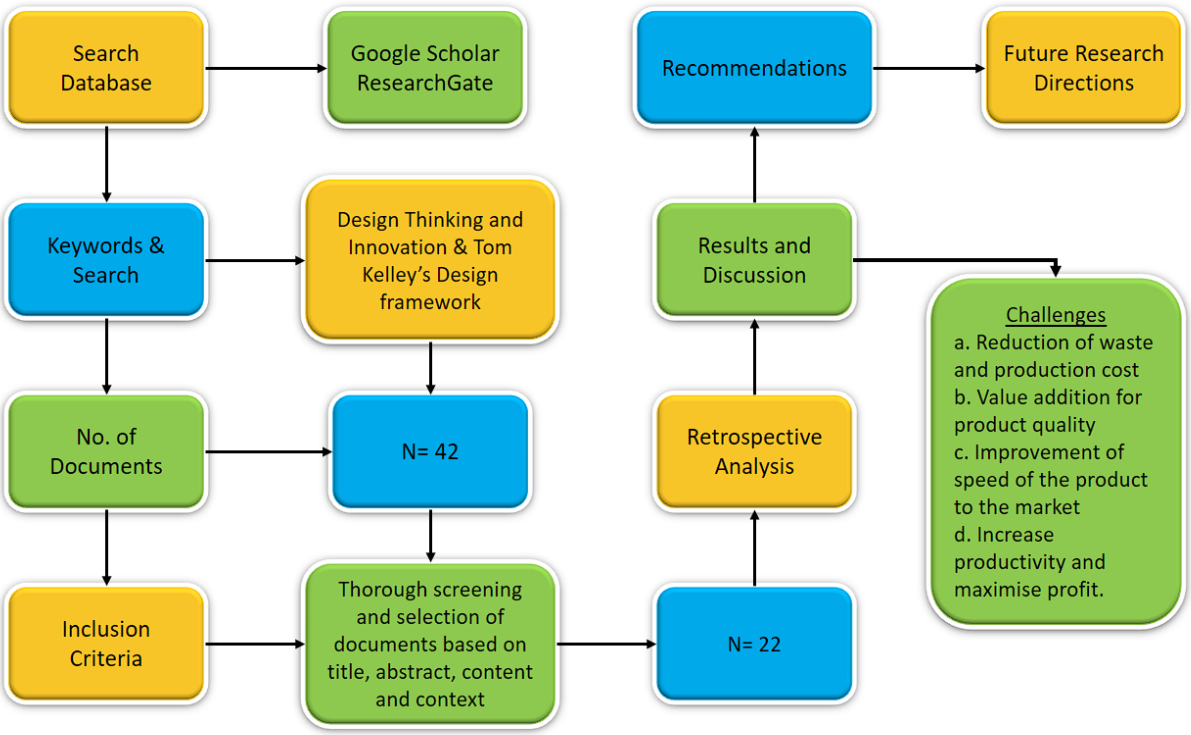

Figure 2: Methodological Flow

The study employed this method to gather secondary data on design thinking, Tom Kelley's design framework and its synergy in applications in various industry from Google Scholar and ResearchGate. The gathered documents were screened and selected based on their related content and context of the study.

Subsequently, data was then evaluated retrospectively to detect patterns, correlations, and causal links. It gave the understanding of how certain factors may have affected outcomes over time in the weaving industry. Through this analysis, the study identified patterns, and causal relationships of some challenges within the Ghanaian weaving industry where innovation and sustainability has become mandatory for its survival in modern business market.

The study utilised this gathered knowledge as basis to employ Tom Kelley's design framework as design thinking model to address challenges such as reduction of waste and production cost, value

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

addition for product quality, improvement of speed of the product to the market and increased productivity and profit maximisation in the Ghanaian weaving industry. Finally, recommendations and future directions were suggested for Ghanaian weaving industry to consider the implementation of the findings from Tom Kelley's design framework.

Conceptualisation of Tom Kelley's Venn Diagram in Ghanaian Traditional Weaving Industry

As highlighted by (Cristache, 2021; Mike, 2021; Vinney, 2022; O'Donoghue (2023) this popular and versatile framework is used to test ideas, concepts and hypotheses to determine the unique value proposition of a successful product in various industries. It is believed that the synergy of Tom Kelley's design framework can be conceptualised in this context to assess its practicability in the Ghanaian traditional weaving industry.

The philosophical underpinnings of the conceptual framework were adopted from the DVF design framework with add-ons to explain the idea of the researcher in the synergy of the three key properties in the Ghanaian weaving tradition. The focus of this DVF design framework is user-centric and its methodology is iterative and flexible in approach. Moreover, it is known to be versatile and adaptable in solving problems within the business world as propelled by Mike (2021).

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

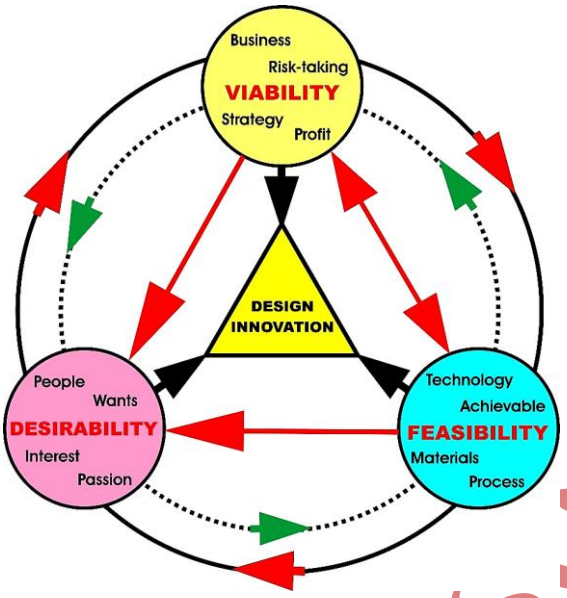

Figure 3: Researcher's Conceptual Framework
(Image Source: Apau, 2024)

In order to relate the conceptual framework in the context of Ghanaian traditional weaving, the framework was rendered with images to give a clearer picture of the conceptual framework in the context of the study. This is exhibited in figure 4.

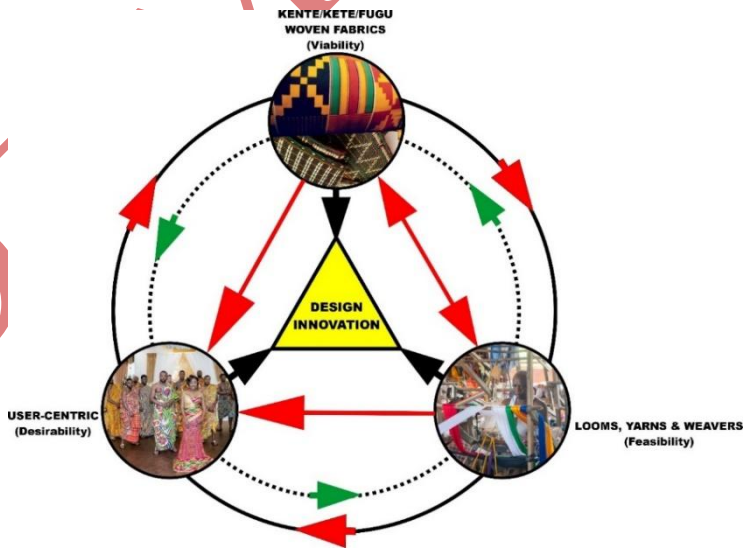

Figure 4: Researcher's Conceptual Framework in Images
(Image Source: Apau, 2024)

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Results

The conceptual model created focus on the iterative approach where the study reveal the design model's operandi to be clockwise or anti-clockwise movement. It is propelled that the synergy of these elements can work from both angles (counter-intuitive) in solving design and product innovation problems in the Ghanaian weaving industry.

This is because these elements can be interdependent and interrelated in a cyclical approach in solving a problem as attested by Rife et al. (2021) that a change will lead to another until it is spiral inwardly towards the intersection of the three lenses to ascertain success.

The desirability dimension dwells on people, their wants, interest, and passion about the Kente, Kete, and Fugu fabrics produced from the industry. Design thinking is user-centric where priority is given to consumer needs. Therefore, the source of viability of the industry is deeply connected to the perspective of this dimension.

In considering the feasibility section of the design framework, the methods, techniques, materials, tools and processes employed in the industry was outlined. This section is identified as the pivot of design thinking where consumers' desires are understood and transformed into business ideas.

The business, risk-taking, strategies, and profit pointers make the viability segment of the design framework. The interconnectedness of desirability and feasibility drives the viability of the industry in its design and product innovation. This will determine the level of competiveness and technological advancement in the Ghanaian weaving industry.

Amidst the challenges exposed by King et al. (2024), it is unravelled that the Ghanaian weaving industry's failure to employ design thinking has brought a significant decline in traditional weaving practices affecting the demand and supply of handwoven fabrics in the business space. Again, lack of design thinking and innovative has crippled the industry's ability to compete against the rising influence of foreign textiles. Furthermore, the conservative design practice in the industry has also limited the various opportunities for innovation through design thinking.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Churchchill (2018) concludes that to solve the world's problems, there is the need for design thinking, which focuses on looking at issues from various perspectives instead of deep thinking. When creating something new in the world, these factors must be considered: the technical factor, the business factor, and the human factor.

Discussions

To address the issues confronting the Ghanaian weaving industry, a conceptual framework was created utilising Tom Kelley's Venn diagram, which combines three critical components: desirability, feasibility, and viability. This framework is a strategic tool for addressing specific industrial concerns, ensuring that solutions are not only creative but also realistic and sustainable.

Therefore, this conceptual design framework was employed to analyse, and discuss possible design thinking and innovation solutions for the Ghanaian weaving industry on challenges such as; reduction of waste and production cost, value addition for product quality, improvement of speed of the product to the market and increased productivity and profit maximisation.

a. Reduction of Waste and Production Cost

Waste is defined as undesirable and unusable items that are considered worthless. Waste may also be defined as any substance that is disposed after its primary use or has no further use (Kapoor, 2023). In the Ghanaian weaving industry, waste is a necessary evil that is added for technical purposes but left unused after weaving thereby becoming a challenge in the industry. Solid waste identified are yarn excess on the loom and possible sloughing-off during and after the weaving process. In this case, the identified waste is minimal in this context to draw a lot of attention.

Notwithstanding, these minimal waste can be accumulated to be heavy waste bills if not attended to immediately over a period of time. Weavers through the process of design thinking, can reduce, recycle, and reuse these loom waste into other desirable products like accessories making, wrappings, yarn braiding and cording etc., which can go a long way to reduce the loom waste and sustain the weaving industry. Van der Hoogt (2016) reveals that loom wastes can be transformed

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

into dishmops, dishtowels, rugs etc. Moreover, these identified wastes can be used to create artefacts for souvenirs as hand bangles or any form of yarn craft to create other job opportunities for the youth. The issue of waste reduction dwells on feasibility dimension of weavers to be practically manageable with raw materials during and after production. Arsenieva et al. (2020) propel that numerous studies have shown that companies may greatly increase their profitability by streamlining their manufacturing processes and cutting waste.

On the other side, the production cost reduction can be traced from the raw materials used for weaving. The major production challenge in this industry is raw materials i.e., yarns. It is revealed that efficiency in sourcing and usage is crucial since raw material prices frequently account for a larger portion of production expenses than energy costs (Rivera et al., 2016). Apparently, if the yarns are expensive coupled with the design demand by users, the weaver can only adjust the price to break even in worst cases or make profit to be in business. However, users demand for affordable yarns and simple designs will relatively reduce the working stress of weavers, thereby causing reduction in production cost. In the other way round, the higher the demand from users for expensive yarns, complex design coupled with high technical production, will increase production cost. There is a strong relation between desirability and feasibility in this context which affects business viability. Therefore, the confluence of these three dimensions come into play to ascertain an innovative and smart ways to curtail production cost challenges.

b. Value Addition for Product Quality

The Ghanaian weaving industry should introduce innovate materials, skills, methods and equipment in production to improve the quality as far fabric behaviour, properties, designs and applications are concerned to widen the market scope of handwoven fabrics globally. Dickmann (2023) opines that to better serve customers, one approach is to enhance the product's features and quality. This may be accomplished by doing research and development to produce novel, cutting-edge goods that outperform those of competitors.

In the weaving industry, high-quality raw materials (yarns) will produce high-quality products all things being equal. This relationship is influenced by users' desire, status and wealth to dictate

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

woven fabrics' added value and quality through the philosophy of materialism. Therefore, the three key elements i.e., viability, feasibility and desirability should be used to test ideas, concepts, and hypothesis to determine the unique value proposition of woven fabrics and its worth of pursuit as attested by Vinney (2022) in quest to achieve the goal sustainability.

The weaving industry through the weavers produce to satisfy the costumers. In this regard, clear quality standards need to be set for hand woven fabrics and be maintained to define the quality of the product. Writer (2020) highlights that one of the most crucial things to do to achieve long-term profitability and sales growth is to improve product quality. Additionally, establishing quality practices into regular procedures is essential for businesses looking to enhance the quality of their products. Moreover, users of woven fabrics should communicate any woven defect fabrics or low quality woven fabrics to stakeholders to take the necessary actions to maintain the desired value as propelled by Hunter (2015) that this will help leverage design challenges.

c. Improvement of Speed of the Product to the Market

To improve the speed of woven fabrics to the market, the industry should identify its target market and the problems it intends to solve for consumers. Gonçalves (2024) explains that the speed at which a product reaches its target market, significantly impacts an organization's competitive positioning, profitability, and customer satisfaction. This will assist the industry to focus and streamline the development process. Again, sellers should conduct market research from users to understand their needs, preferences and proposed solutions.

One of the major set-backs of the weaving industry is production speed due to lack of advanced and latest application of technology. Unfortunately, in its current practice, traditional weavers employ obsolete practices in fabric weaving. It is recommended by Asinyo et al. (2021) that there is a need for weavers to embrace new technology to improve production levels and increase revenue. Weavers should embrace new technologies to speed-up the numerous preparation processes which will give more design space for innovation to produce more fabrics within a limited time frame.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

The weaving industry should introduce tools, accessories that are semi-automated to facilitate the weaving process as hand or manual weaving processes significantly reduces the production speed of woven fabrics. However, in all these, the quality of woven fabrics should not be compromised or should not affect customer satisfaction because the pivot of this model is user-centric.

d. Increase Productivity and Maximise Profit

Apparently, this is a major set-back in the Ghanaian weaving industry as almost all production techniques and activities are manual and obsolete. This situation does not increase production and therefore directly affects profit maximisation. Taddeo (2021) illumes that because productivity and profitability are interrelated, an organization's capacity to succeed is mostly determined by the productivity of its workforce. In general, a company's profitability increases with its degree of productivity. Put differently, businesses that are productive make money in a variety of ways.

The weaving industry should think of leverage technology and automation to streamline repetitive and time-consuming tasks. When weavers are equipped to increase production, it will boost the market thereby maximising profit in the industry. This challenge does not need the involvement of the user but explicitly the interrelation between the business and the technology at hand to satisfy the people in this context.

Additionally, this set-back goes further to affect time management which to an extent affect productivity and delivery to customers. It is a problem when products are not delivered on time to the customer. It is revealed that consumer expectations can be fulfilled, retained, and remain competitive in the digital era by putting a high priority on on-time delivery and putting successful methods into practice (Connext Global Solutions, 2023). In resolving this situation, the viability and feasibility dimensions should research on how to find ways to introduce novel ways such e-commerce and online shopping to maximise profit.

The above discussions is summarised in a simple chart for visual analysis in figure 3. This chart assist the interrelations between these pointers in the industry and how the three key dimensions

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

of Tom Kelley's design thinking model independently or dependently play significant role in addressing these challenges in the Ghanaian weaving industry.

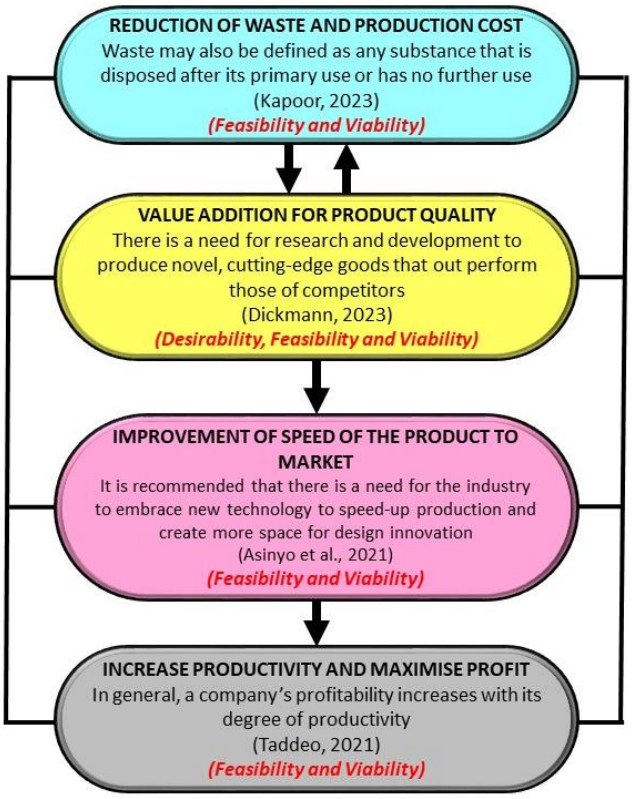

Figure 3: Interrelations between feasibility, desirability and viability in Ghanaian Weaving Industry

(Image Source: Apau, 2024)

Conclusion

It is inevitable the relevance of Tom Kelley's Venn diagram in solving design problems across various industries. The synergy of this theoretical framework is a very powerful tool to solve design problems as posited by Cristache (2021). Even though many Ghanaian industries have not fully explored this design thinking model, its applications is steadily germinating in Ghana.

It is evident that the synergy of the three elements or lenses of innovation as referred to by Krithika et al. (2021) can assist the Ghanaian weaving industry to solve various design and production

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

challenges. The study revealed that each facet of the model to an extent can be independent but its effective approach is powerful to give designs purpose and increase the value of design solutions when synchronised in any problem-solving activity as attested by (Mike, 2021; Cristache, 2021).

In reducing production waste and cost, the feasibility and viability dimensions need to interrelate to manage the waste produced in the industry and how to decrease production cost. There is a need for research and development to produce novel, cutting-edge goods that outperform those of competitors to add value for product quality. The speed of product to market dwells much on the industry's production line. If much of the numerous processes are cut down, it will improve the product speed as recommended by Asinyo et al. (2021). Finally, as unearth in the study, higher productivity leads to higher profitability Taddeo (2021). Even though, productivity and profitability is appreciated, more can be achieved if Ghanaian weaving industry can advance in semi-automated or fully automated systems and technology in their production line.

Recommendation

Even though the synergy of the three elements is applicable in solving various design problems in the industry, the sustainability and innovation of the Ghanaian weaving industry dwells much on the feasibility and viability dimensions of the model. Again, the study advise that the industry should embrace new technology to step up its competitiveness in modern business landscape. The weaving industry was also directed to regularly undertake research and development in design thinking and innovation to unravel diverse production and product innovations.

Therefore, it is recommended that stakeholders of the industry should focus on the technological aspect of the industry. If this condition is met, it will boost and resolve most design challenges and problems identified under waste and cost reduction, value addition, product speed and profit maximisation in the weaving industry.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Limitations and Future Studies

Even though, the study analysed and discussed some challenges in the Ghanaian weaving industry via Tom Kelley's design framework, there is potential biases in secondary data gathering as propel by Owa (2023). Therefore, it is directed that future studies should also consider primary data collection methods, such as interviews together with secondary data to gain deeper insights into the weaving industry's challenges.

References

Afriyie, A., Frimpong, C., Asinyo, B., & Seidu, R. (2021). A Comparative Study on the Techniques, Tools and Materials for Indigenous Weaving in Ghana. TEXTILE, 21, 69 - 89. https://doi.org/10.1080/14759756.2021.1989940.

Akinny, W. D. (2016). Investigating the desirability and feasibility of the 'Old People's Home' as a viable business in Ghana (Doctoral dissertation).

Apau, E., Howard, E. K., & Asempapah, M. X. (2022). Assessment of Empathy in Design Thinking Model: A Case Study of Ghanaian Design Company. JDT, 3(2), 292.

Arsenieva, N. V., Barsova, T. N., Putyatina, L. M., & Lavrova, L. A. (2020). Methodological aspects of efficiency increasing of enterprise's working capital management in modern conditions. Revista Espacios, 41(05).

Asinyo, B., Howard, E., & Seidu, R. (2021). Weaving Traditions of Daboya and Yendi Communities in Northern Ghana. Journal of Arts and Humanities, 10, 39-48. https://doi.org/10.18533/JAH.V10I04.2069.

Ayesu, S., Anokye, D., Fobiri, G., Acquaye, R., & Godomey, B. (2021). Aesthetic and Philosophical Meanings of Indigenous Asante Kente. Textile & Leather Review. https://doi.org/10.31881/tlr.2021.12.

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Boadi, M., Frimpong, C., & Seidu, R. (2023). The Influence of Change on Indigenous Strip-Woven Fabrics in Ghana. Journal of Asian and African Studies. https://doi.org/10.1177/00219096231176740.

Chasanidou, D., Gasparini, A., & Lee, E. (2014, October). Design thinking methods and tools for innovation in multidisciplinary teams. In Workshop Innovation in HCI. Helsinki, Finland: NordiCHI (Vol. 14, No. 2014, pp. 27-30).

Chasanidou, D., Gasparini, A.A., and Lee, E. (2015). Design Thinking Methods and Tools for Innovation. In: Marcus, A. (eds) Design, User Experience, and Usability: Design Discourse. Lecture Notes in Computer Science, vol 9186. Springer, Cham. https://doi.org/10.1007/978-3-319-20886-2_2

Churchchill, E. (2018). Innovation and Design Thinking. Available at: https://medium.com/@churchillemmanuel/innovation-and-design-thinking-620f5062246a (Accessed: October 29, 2024)

Connext Global Solutions (2023). Why On-Time Delivery is Important for Your Business. Available at: https://connextglobal.com/why-on-time-delivery-is-important-for-your-business (Accessed: October 2, 2024)

Cuofano, G. (2024). Design thinking. Available at: https://businessengineer.ai/p/design-thinking (Accessed: November 01, 20204)

Dam, R.F. (2024). The 5 Stages in the Design Thinking Process. Available at: https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process? (Accessed: September 24, 2024)

Deininger, M., Daly, S. R., Sienko, K. H., Lee, J. C., & Kaufmann, E. E. (2019). Investigating prototyping approaches of Ghanaian novice designers. Design Science, 5, e6. doi:10.1017/dsj.2019.5

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Dickmann, E. (2023). How to Increase Product Value. Available at: https://fiveechelon.com/how-to-increase-product-value/ (Accessed: October 5, 2024)

Dunne D., and Martin R. (2006). Design thinking and how it will change management education: An interview and discussion. Academy of Management Learning & Education, 5, 512–523.

Eisert, U. (2014). 2. SAP: Bringing Economic Viability to the Front End of Innovation. Research Papers in Economics, doi: 10.1007/978-3-319-01056-4_26

Frimpong, C., & Asinyo, B. (2013). A Comparative Study of History, Equipment, Materials, Techniques and Marketing Approach of Traditional Weaving in Ghana. Arts and Design Studies, 7, 1-8.

Gekeler, M. (2019). A Practical Guide to Design Thinking. (A collection of methods to re-think social change). Available at: https://library.fes.de/pdf-files/bueros/indien/15404-20190508.pdf (Accessed: September 28, 2024)

Gell, T. (2023). Desk Research: What It Is and How You Can Use It. Available at: https://www.driveresearch.com/market-research-company-blog/desk-research-what-it-is-and-how-you-can-use-it/ (Accessed: September 30, 2024)

Gonçalves, L. (2024). Product Time to Market, the Complete Guide. Available at: https://adaptmethodology.com/blog/time-to-market/ (Accessed: September 24, 2024)

Harjinthar S. (2023). Balancing Desirability, Viability, and Feasibility: The Key to Successful Product Design and Innovation in Design Thinking. Available at: https://www.linkedin.com/pulse/balancing-desirability-viability-feasibility-key-successful-singh/ (Accessed: October 03, 2024)

Inder, S. and Reay, S. (2014). Practice Based and Material Focused: A Craft Approach to Teaching Design Intuition Available at: https://www.researchgate.net/publication/305766702 (Accessed: October 05, 2024)

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Interaction Design Foundation - IxDF. (2016). What is Design Thinking (DT)? Interaction Design Foundation - IxDF. Available at: https://www.interaction-design.org/literature/topics/design-thinking (Accessed: November 01, 2024)

Kapoor, R. (2023). Waste - Know Definition, Sources of Waste and its Types. Available at: https://testbook.com/ias-preparation/waste (Accessed: October 5, 2024)

Kiely, T.J. (2024). What Is Desk Research? Meaning, Methodology, Examples. Available at: https://www.meltwater.com/en/blog/desk-research (Accessed: November 3, 2024)

King, R.S., Simpeh, E.K., Mensah, H. and Nerquaye-Tetteh, E. (2024), "Factors influencing the weaving and use of kente cloth: the case of Bonwire, Ghana", Research Journal of Textile and Apparel, Vol. 28 No. 1, pp. 152-168. https://doi.org/10.1108/RJTA-02-2022-0014

Krithika, R., Natalia, N., Ahuja, S., and Jochen, S. (2021). Design Thinking Implementation for Innovation: An Organization's Journey to Ambidexterity. Journal of Product Innovation Management. 38. DOI:10.1111/jpim.12599.

Micheli, P., S. Wilner, S. J., Bhatti, S. H., Mura, M., & Beverland, M. B. (2019). Doing Design Thinking: Conceptual Review, Synthesis, and Research Agenda. Journal of Product Innovation Management, 36(2), 124-148. https://doi.org/10.1111/jpim.12466

O'Donoghue, J. (2023). IDEO's Desirability, Viability, Feasibility Framework: A Practical Guide. Available at: https://makeiterate.com/ideos-desirability-viability-feasibility-framework-a-practical-guide/ (Accessed: August 28, 2024)

Okai-Mensah, C.K., Howard, E.K., and Osei, M.A. (2021). Implementation of Design Thinking and Innovation Strategies by Ghanaian Companies: A Case of CPC. In: Mojekwu, J.N., Thwala, W., Aigbavboa, C., Atepor, L., Sackey, S. (eds) Sustainable Education and Development. Springer, Cham. https://doi.org/10.1007/978-3-030-68836-3_5

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Owa M. (2023). Desk Research: Definition, Types, Application, Pros & Cons. Available at: https://www.formpl.us/blog/desk-research-definition-types-application-pros-cons# (Accessed: October 31, 2024)

Padi, A., Ansah, W. O., & Mahmoud, M. A. (2022). Corporate entrepreneurship and employees' competencies: Do employees' perceived feasibility and desirability matter? Cogent Business & Management, 9(1). https://doi.org/10.1080/23311975.2022.2102129

Plattner, H. and Zeier, A. (2012). 4. Desirability, Feasibility, Viability – The Impact of In-Memory. doi: 10.1007/978-3-642-29575-1_1

Poku, K., & Ansah, M. O. (2014). Design Thinking as a Strategy for Marketing Confectionery Products: A Case Study of Cocoa Processing Company—Ghana. Business and Management Horizons, 2(1), 48-77.

Rife, N., Syrett, M., Gardner, S., Kohse, J., and Jarr-Koroma, S. (2021). The Innovation Sweet Spot. Available at: https://journal.jabian.com/the-innovation-sweet-spot/ (Accessed: September 26, 2024)

Rivera, M., Antonio, J., and Aikaterini, B. (2016). Production costs from energy intensive industries in the EU and third countries. doi: 10.2790/79502

Shute V. J., and Becker B. J. (2010). Innovative assessment for the 21st century. New York, NY: Springer-Verlag.

Stokol, T (2020). The Role of Design Thinking in the Design Process. Available at: https://www.cxpa.org/blogs/ian-stokolccxp1/2020/06/22/the-role-of-design-thinking-in-the-design-process (Accessed: October 29, 2024)

Taddeo, J. (2021). 3 Easy Ways to Maximize Employee Productivity and Profitability. Available at: https://www.universalcreativesolutions.com/insights/post/3-easy-ways-to-maximize-employee-productivity-and-profitability (Accessed: October 6, 2024)

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).

Van der Hoogt, M. (2016). Ask Madelyn: Uses for Loom Waste. Available at: https://handwovenmagazine.com/uses-for-loom-waste/ (Accessed: September 30, 2024)

Vekinis, G. (2023). Viability, Not Just Feasibility. Management for professionals, doi: 10.1007/978-3-031-44358-9_19

Ven, S.T. (2023). Re: What is the dichotomy of desk review and Literature review?. Available at: https://www.researchgate.net/post/What_is_the_dichotomy_of_desk_review_and_Literature_review/645a0484df3abca7a60bd1a7/citation/download. (Accessed: October 2, 2024)

Vijayamohan, P. (2024). Desk Research 101: Definition, Methods, and Examples. Available at: https://surveysparrow.com/blog/desk-research/ (Accessed: October 30, 2024)

Vinney, C. (2022). Desirability, feasibility and viability diagram: What does it mean? Available at: https://www.uxdesigninstitute.com/blog/desirability-viability-and-feasibility/ (Accessed: September 15, 2024)

Writer, S. (2022). 5 Ways to Increase Product Quality. Available at: https://smallbusinessrainmaker.com/5-ways-to-increase-product-quality/ (Accessed: October 1, 2024).

Yurii, K. (2022). Search of multifunctional vehicles using the Venn diagram and morphological analysis. DOI: 10.62853/gqpb9330

DVF design thinking model refers to a framework that integrates desirability, feasibility, and viability in design processes (Stokol, 2020).