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THE INFLUENCE OF A CAD DESIGNER'S CREATIVITY ON ENHANCING THE QUALITY OF A NEW INNOVATIVE PRODUCT

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ABSTRACT

A CAD designer is a creative professional with a strong sense of aesthetics, harmony, and visual composition. They typically work daily on visual presentations across various media, designing web pages, banners, newspaper advertisements, signage, logos, magazine covers, video credits, animations, and product prototypes — all of which constitute the core subjects of their work. This study investigates how both environmental and personal contextual factors influence each CAD designer. Environmental influences include family, workplace, and education. Personal factors are gender, age, lifestyle, habits, social background, education, occupation, character, and behavioral patterns. These factors influence the seven core traits of a creative personality, ultimately enhancing the quality of an innovative product. To explore this, a standardized questionnaire was used to assess the seven core creative personality traits. The results are as follows: Associativity (35%), Originality (17.5%), Motivation (22.5%), Ambition (11.25%), Flexibility (7.5%), Emotional instability (3.75%), and a lower level of sociability (2.5%). Data were obtained through surveys among CAD designers and their collaborators. A total of 80 valid questionnaires were collected from 23 companies in Serbia that specialize in computer design. An additional objective is to establish the relationship between creativity and design in the work of CAD designers who develop new products.

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1 INTRODUCTION

Computer-Aided Design (CAD) encompasses the application of computer technology in the creation, modification, analysis, or optimization of product or process designs. A computer-aided designer is engaged in the use of digital tools to support and enhance the design process. CAD first appeared in a practically usable form in the mid-1960s. Patrick J. Hanratty, recognized as one of the pioneers of software development, is often referred to as the father of CAD software. He developed the first numerical control system, which later evolved into what is now known as Computer-Aided Design (Baltes, 2024). Its implementation enables the design of geometries with complex and unconventional forms (Manavis et al., 2024). Essentially, CAD represents a shift from traditional manual drafting methods—such as sketching on paper—to digital processes that enhance precision and efficiency. Ultimately, computer-aided design is driven by the designer's inspiration, who simultaneously assumes the roles of both artist and engineer. The increasingly nuanced role of technicians, engineers, and computer programmers in the development of technologies that shape our social, emotional, and intimate lives is being examined, alongside advocacy for the use of art as both a context and a tool. Art is promoted to help professionals cultivate sensitivity and critical thinking, in addition to their technical skills. In a world where technology evolves at an exponential pace, the integration of computer-aided design into product engineering processes represents a pivotal turning point. (Innella & Rogers, 2021) Engineering design is fundamentally rooted in the process of creating new and compelling products, systems, and services. It is a complex task that requires balancing multiple objectives and attributes simultaneously (Diakun & Grzejda, 2025). Numerical methodologies based on sketches aim to achieve optimal solutions for product design, bridging the gap between initial conceptual sketches and advanced engineering analyses (Charalampous, 2025).

2 LITERATURE REVIEW

The study of creativity provides rich opportunities for interdisciplinary research across engineering, cognitive science, and computing (Fu et al., 2018). A CAD designer is a creative individual with a sense of aesthetics, harmony, and good composition (Casakin & Goldschmidt, 1999).

Understanding how designers think is of great interest—not only to designers seeking better insight into their own cognitive processes, but also to CAD designers at all levels, from beginner to advanced (Aydin & Aktas, 2020; Ceylan, 2021; Rasouli et al., 2023). The history of the use of information and communication technologies (ICT) in computer-aided design is relatively short when compared to the development of traditional design methods. ICT has had a revolutionary impact on the field of computer design (Stojanov et al., 2025).

A new dynamic theoretical framework is being introduced into the creative process, consisting of a psycho-biological layer, a contextual layer, and a layer of creative states (Agnoli, 2025). Research areas such as divergent thinking, brainstorming, and scientific productivity remain highly relevant (Kalargiros & Manning, 2015).

Researchers have demonstrated that certain personality traits are associated with creative individuals, particularly designers (Wang et al., 2023; Karpova et al., 2013; Puccio & Grivas, 2009). Changes in both the internal and external environment, as well as the enhancement of capacities for independent innovation in new products, have been analyzed (Xue, 2025). Research on the Big Five personality traits has shown that openness to experience is positively correlated with creativity. Similar but statistically weaker evidence was found for the relationship between extraversion and creativity. Contrary to most previous findings, a negative correlation between conscientiousness and creativity was also observed (Jirasek & Sudžina, 2020). One study investigating the influence of the Big Five personality factors on leadership behavior reported regression analysis results as follows: openness to experience 0.12, openness 0.03, agreeableness 0.16, conscientiousness 0.29, and emotional stability 0.11 (Sajfert et al., 2017). Supporting the hypothesis, the regression results indicate that, after controlling other characteristics, conscientiousness is significantly associated with the Ethical Leadership Scale ($r = 0.29$, $p < 0.01$). Terek Stojanović et al. (2023) examined the impact of Big Five dimensions. Extraversion, openness to experience, and narcissism have the

strongest positive influence on dimensions of the Theory of Planned Behavior. Generally, narcissistic individuals hold a high opinion of themselves, are confident, and are highly motivated to achieve success, wealth, and admiration from others.

Four creative traits have been identified: diverse thinking processes, determination, open-mindedness, and risk-taking (Karpova et al., 2013). Combining individual differences with a sociocultural perspective on creative personality allows for a better understanding of the transition from potential to creative achievement, even when established predictors such as intelligence and divergent thinking are considered (Lebuda, 2025).

Creativity focuses on idea generation, whereas innovation emphasizes the implementation of ideas (Rank, Pace, & Frese, 2004; Lebuda, 2025; Wang et al., 2023). Creativity is often regarded as the initial step of innovation (West, 2002). Many caution that creativity does not only occur in the early stages of innovation processes; rather, through cyclical and more complex patterns, it boils down to a simpler process of idea generation and implementation. Three distinctions between creativity and innovation have been identified (Anderson et al., 2018):

1. Creativity may involve only the generation of creative ideas. Innovation, however, must include the deliberate introduction and application of new and improved ways of working.
2. Innovation must relate to benefits at one or more levels of analysis, which is not necessarily the case for creativity.
3. Innovation is not new to the organization, but is usually a blend of emergent processes, adopted or adapted procedures, and creative responses.

The distinction has been examined from a motivational perspective, with the assertion that creativity is driven by intrinsic motivation, whereas innovation is driven by external incentives and the need to surpass previous standards Clydesdale,(2006). The balance theory between originality and effectiveness was used to differentiate these two concepts (Runco, 2025). Creativity (especially artistic creativity) places greater emphasis on originality, while innovation requires that effort be useful and marketable (effectiveness). Since the determination of the effectiveness of innovative effort is a social rather than a personal process, innovation is primarily an interpersonal-social process, whereas creativity is more of an interpersonal-cognitive process (Anderson et al., 2014). Creativity and innovation are interconnected constructs and are often used interchangeably by laypeople.

Researchers aim to determine the potential for entrepreneurs to be as innovative and creative as possible, Ikbal, (2022). Innovation research defines innovation as the application of new ideas, which people disseminate over time, capable of innovating and adapting old ideas. The study explains the mechanism through which an innovative organizational environment mediates the relationship between entrepreneurs and employees' innovative work behavior (Kreiner et al., 2022).

The innovation processes address the issues of technical creativity and invention. The term "creative process" will be used in the following discussion, although this term has a broader meaning in human creativity. The outcome of such innovation processes is an original solution to a specific technical problem (an invention – innovation protected by a patent) or, in less creative cases, a technical improvement of an already known technical solution. Invention represents the highest achievement of human intellectual capacity and creativity in the field of technology.

Secondly, there is a negative correlation between conscientiousness and creativity, especially among artists. Besides this, findings on the relationship between other Big Five personality traits and creativity are inconsistent. For example, while some studies find a positive association between extraversion and general creativity measures based on domain-specific criteria, others suggest the opposite trend: a link between introversion and creativity among artists and writers. Even among scientists, the correlation is complex, as scientists tend to be more introverted than non-scientists, yet creative scientists are more extraverted than less creative ones. Although some studies tend to portray a less favorable image of creative scientists and artists, this result does not apply to samples of American adults or Chinese students.

3 METHODOLOGICAL CONCEPT OF RESEARCH

3.1 Problem and subject of research

When discussing the design of a product, object, or any other item, the term "design" refers to the integration of elements that constitute the entirety of the product. Field studies, which follow a defined on-site methodology, are commonly referred to as a recognized scientific domain. Such studies on the application of design in the development of new products generally provide evidence that their role is indispensable in this process. Computer-aided design represents a field that explores the interaction between humans and the technologies of the digital age. Research has shown that increasing the perceived efficiency of CAD designers enhances their motivation, thereby increasing the likelihood that they will remain with their current employer. The data obtained were used as a basis for developing a model for improving product quality in the computer design sector of domestic enterprises. The primary objective of this survey was to gain insight into potential influential relationships between factors that additionally affect the business performance and competitiveness of domestic firms in computer design.

The research presented in this paper will be based on facts derived from the analysis of the latest theoretical insights and practical achievements in the field of computer-aided design. A content analysis and synthesis of the literature will be applied, from which conclusions will be drawn based on the general premises of the research.

3.2 Review of Existing Research in the Field

A questionnaire examining the seven core traits of a creative personality was employed, based on the work of Martinsen (2011).

3.3 Research Objectives

The main objective of this research is to enable human resource managers to utilize the obtained results in assessing the creative abilities of computer-aided designers—specifically, to determine whether a designer possesses the necessary qualities to meet the demands of a position within a company seeking to hire them.

This research pursues a societal objective: to provide scientific insights that support social measures advancing and improving computer-aided design.

The scientific objective is to achieve a certain level of theoretical understanding regarding how creativity in computer-aided design professionals affects their professional competencies and conceptual abilities in the creation of new, innovative products.

A further goal of the study is to determine, through scientific analysis, whether there is a measurable impact of creative computer-aided designers on the functional characteristics of newly developed, innovative products.

The research also aims to demonstrate that a computer-aided designer who acquires specific knowledge—gained through dialogue with prospective customers regarding product features—will be capable of conceptualizing and designing an object that incorporates the required characteristics.

Finally, the study highlights the role of the computer-aided designer as a key driver within a company, emphasizing their importance in establishing effective communication and enhancing the organization's competitiveness in the marketplace.

3.4 Expected Results and Hypotheses

The research will aim to determine the extent to which creative computer-aided designers influence the functional characteristics of a new product.

Creative behavior exhibited by computer-aided designers serves as the fundamental principle upon which the hypotheses of this study are formulated.

3.4.1 Main Hypothesis

There are statistically significant relationships between the dimensions of creative computer-aided designers and their influence on the characteristics of a new, innovative product.

3.4.2 Specific Hypotheses

H_1: There are statistically significant correlations between dimensions of creativity and designing new products.

H_2: There are statistically significant correlations among the dimensions of the seven core traits of the creative personality.

H_3 relies on divergent thinking, the ability to generate different and original ideas related to the design problem. This paper represents a research process that stimulates imagination and connects seemingly unrelated ideas.

3.5 Research Methods

Based on the conclusions of previous studies and the conceptual literature, specific assumptions were introduced for the purposes of this research. These assumptions provided the foundation for constructing original research frameworks, which in turn shaped the study's structure and informed the determination of representative sample sizes.

This study is grounded in assumptions derived from prior research and conceptual literature, which have informed the development of original research frameworks. These frameworks guided the overall structure of the study, including the determination of representative sample sizes.

The following methods will be presented and analyzed as part of the research process: Content analysis method**,** Expert-based scientific examination methods (specifically, a questionnaire used for data **c**ollection), and **d**ata processing methods**.** All collected data were analyzed using IBM SPSS Statistics, a statistical software package employed to ensure the accuracy and validity of the research findings.

3.5.1 Questionnaire Distribution and Data Collection

Each respondent was initially contacted by the researcher via telephone. Upon receiving consent to participate, the respondent was sent a cover letter along with technical instructions for completing the electronic questionnaire. The study involved participation from new product designers and their collaborators. For the processing and statistical analysis of the collected data, the software package IBM SPSS Statistics (Statistical Package for the Social Sciences) was used.

3.5.2 Presentation of Research Results

Figure 1 illustrates the gender distribution of respondents from the surveyed population of computer-aided designers. Based on the results obtained through tests conducted using Google Forms, 40% of the digital designers were female (n = 32), while 60% were male (n = 48).

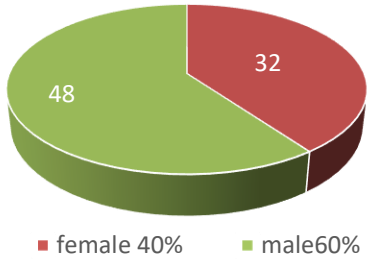

***Figure 1**. Gender of respondents*

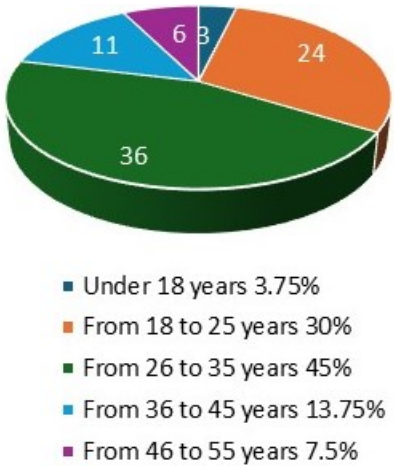

***Figure 2**. Age distribution of respondents (in years)*

Figure 2 illustrates the age distribution of computer-aided designers**.** A total of 3.75% of respondents were under 18 years of age. Respondents aged between 18 and 25 years made up 30% of the sample, while the largest group, 45%, was between 26 and 35 years old. Those aged between 36 and 45 years accounted for 13.75%, and 7.5% were between 46 and 55 years old. No respondents over the age of 55 were included in the survey.

Figure 3 shows the responses of CAD designers concerning their completed education: 16.25% completed high school. 2.5%, completed secondary vocational school. 20%, graduated from a college of vocational studies. 18.25%, completed the master's degree at the College of Vocational Studies. A total of 31.25% obtained their degrees through the Faculty of Academic Studies. Ten percent of them completed master's academic studies. 1.25% have a doctorate.

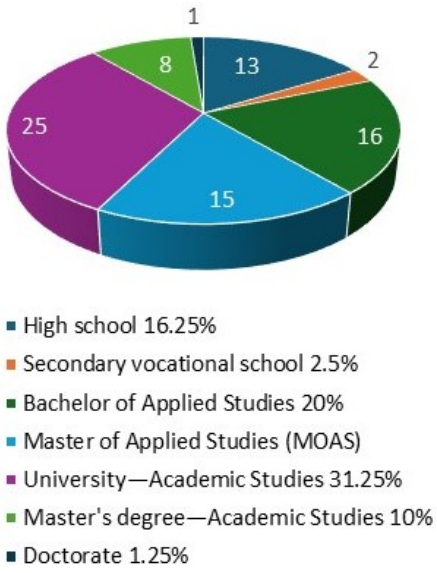

Figure 3. *Education of respondents*

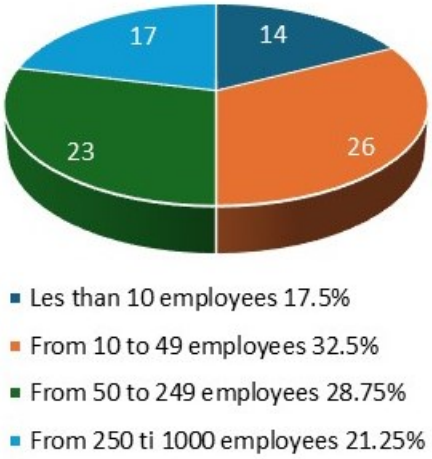

Figure 4. *Number of Employed Respondents within the Organization*

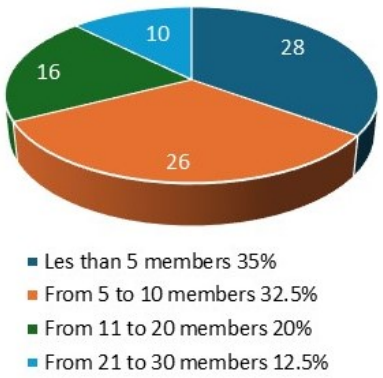

Figure 5. S*ize of the design team*

Figure 4 presents the distribution of employed CAD designers across different organization sizes. Specifically, 17.5% work in organizations with fewer than 10 employees, 32.5% in organizations with 10 to 49 employees, and 28.75% in organizations with 50 to 250 employees. Finally, 21.25% are employed in organizations with 250 to 1,000 employees.

Figure 5 illustrates the size of design teams within organizations. **O**rganizations with fewer than 5 designers represent 35% of the total. Design teams consisting of 5 to 10 members account for 32.5%. Teams with 11 to 20 designers represent 20% of the total. Finally, teams with 21 to 30 designers comprise 12.5%.

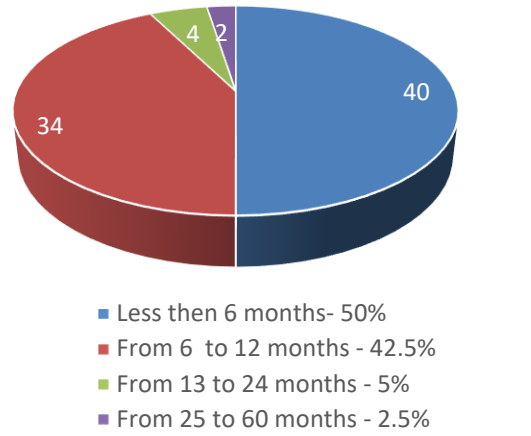

Figure 6. *The planned period of production of the designer's new product*

Figure 6 presents the responses to the question on the planned period for developing a new product by CAD designers: less than 6 months (50%), 6–12 months (42.5%), 13–24 months (5%), and 25–60 months (2.5%).

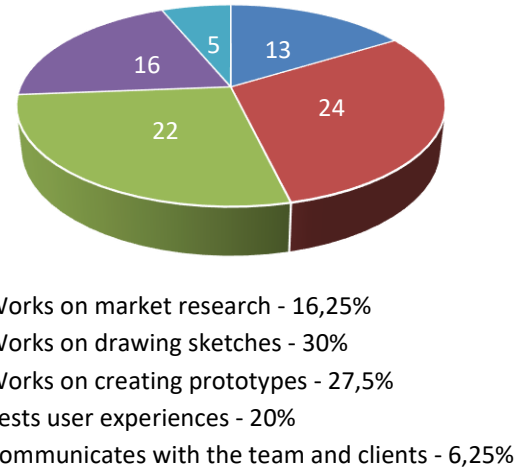

Figure 7. *Skills Required for the Role of a Computer Designer*

Figure 7 presents the responses to the question regarding the tasks most performed by computer product designers. A total of 16.25% of

respondents reported that they work on market research. 30% indicated that they create sketches. 27.5% stated that they develop prototypes. 20% reported that they test user experience. Finally, 6.25% indicated that they maintain good communication with clients.

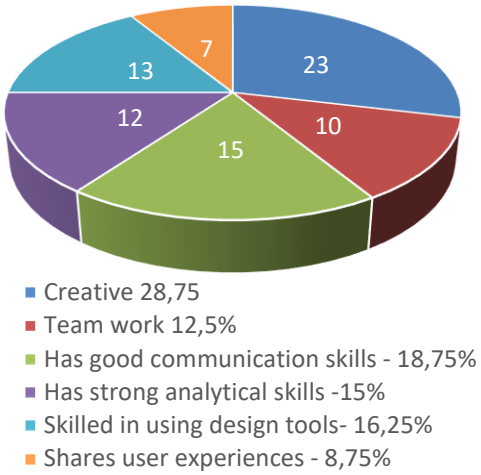

***Figure 8**. Skills required for the position of CAD designer*

Figure 8 presents the responses of participants to the question: *Which of the following skills is the most important for working as a computer product designer (choose one)?* A total of 28.75% of respondents selected creativity as the most important skill. 12.5% chose teamwork. 18.75%, selected communication skills. 15% chose analytical abilities. 16.25% selected proficiency in design tools. Finally, 8.75% selected sharing user experiences.

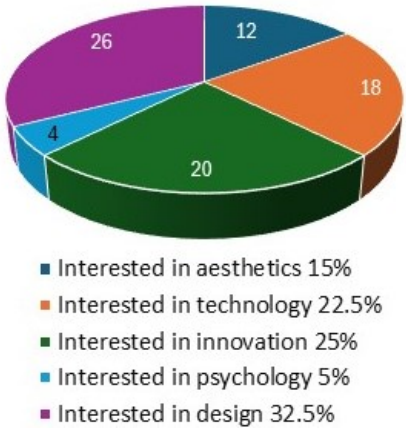

***Figure 9**. Individuals aspiring to become computer product designers*

Figure 9 shows that individuals aspiring to become CAD designers are most often interested in aesthetics, as indicated by 15% of respondents. 22.5% of them declared their interest in technology. 25% of them expressed interest in innovations. 5% of them expressed interest in user psychology. 32.5% of them declared their interest in design. The findings highlight that user experience may be enhanced by addressing users' frustrations and emotional reactions to technology during the design process (Taylor, 2024). In addition, Zhou (2023) emphasizes that creative products differ significantly from ordinary goods, requiring careful consideration of human psychology in both their design and evaluation.

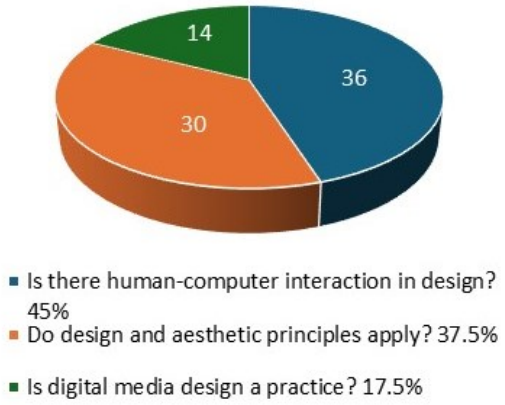

***Figure 10** Criteria most often applied in computer design*

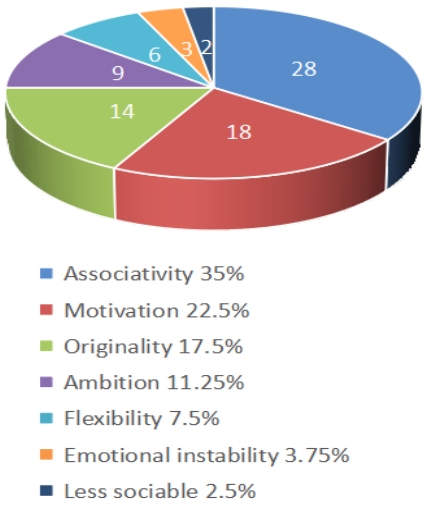

***Figure 11:** Seven Core Traits of Creative Personalities*

Technological development and new conceptions of the *user* now require more interdisciplinary approaches to design.

Figure 11 shows the answers to the respondent's question: Which of the seven basic characteristics

of creative personalities do you have? Respondents' answers to the question: Which of the seven core traits of a creative personality do you possess?

For a long time, there has been a myth about the "tortured artist," locked away in a studio, working on their ideas in complete isolation from the world. According to Martinsen (2011), this stereotype may not be far from the truth. His study revealed that seven factors explained significant differences between creative and non-creative groups, with an explained variance of 69.9%. These factors are associative orientation, motivation, ambition, emotional instability, originality, resourcefulness, and flexibility.

The Myers-Briggs Type Indicator (MBTI) attempts to classify personality based on four dichotomies: introversion versus extraversion, sensing versus intuition, thinking versus feeling, and judging versus perceiving. However, the Myers test is less suitable than Martinsen's model and its explanation of personality traits.

However, *the Myers-Briggs test* is less suitable since the introduction of Martinsen's model, it has been considered more insightful.

The personality traits of a creative scientist have been identified across four aspects: personality, thinking ability, research capability, and uniqueness.

The results showed that thinking ability was the best identifier of creative scientists, while personality traits were the best predictors of less creative ones.

3.5.3 Model for Improving Product Quality in Computer Design

Based on research into the opinions of CAD designers regarding the quality and competitiveness of new innovative products, as well as creativity studies, a theoretical model has been developed to improve product quality in computer design within domestic companies.

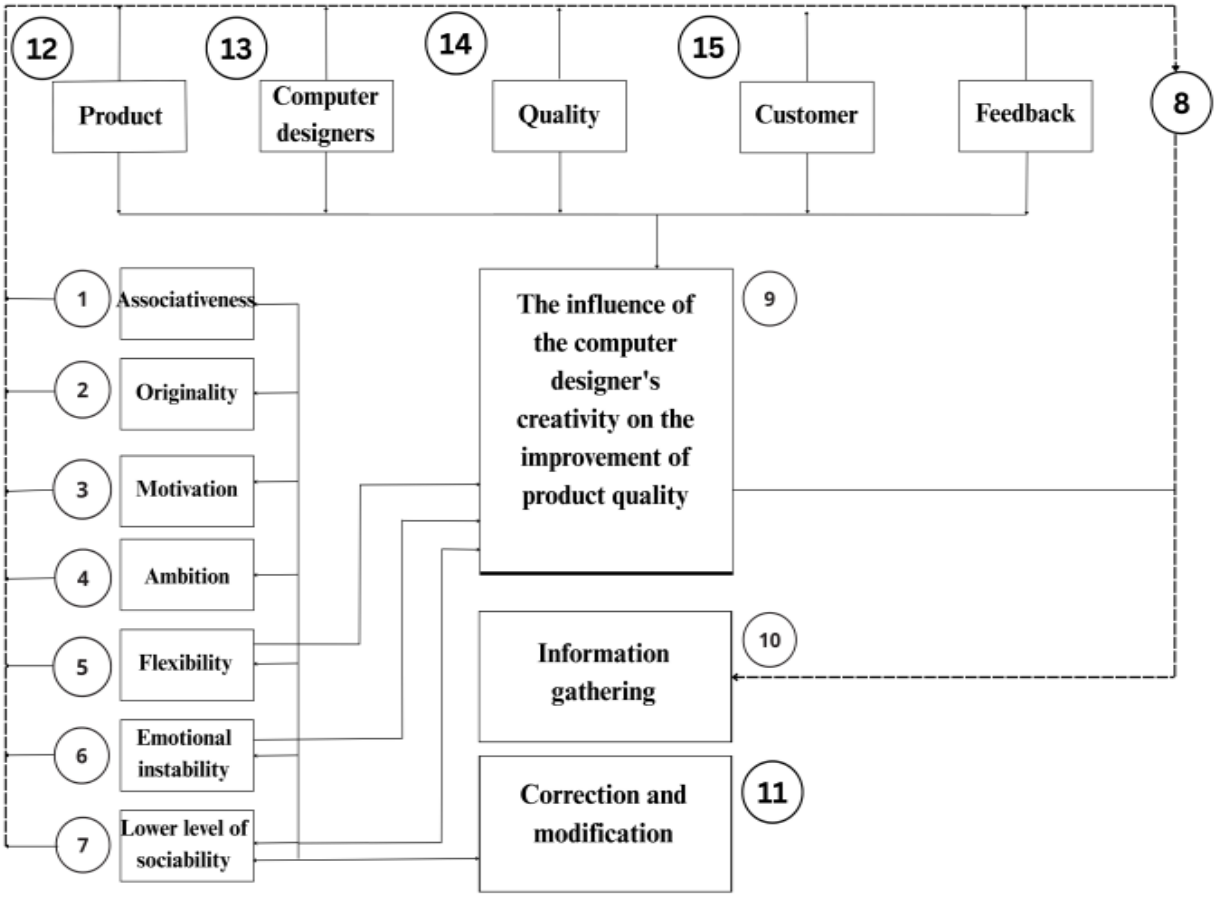

Figure 12 *Model for Improving Product Quality in Computer Design*
Source: Adapted from Martinsen (2011)

The main principle on which the model operates is the PDCA cycle (Plan–Do–Check–Act), where each cycle introduces improvements within specific creative activities. The model is based on the continuous improvement of business activities, with the aim of enhancing both design quality and overall business performance.

The model integrates interconnected elements, including an information collection process and a correction/modification process. Based on the collected and analyzed information, necessary adjustments are made to business processes or activities. The three main components of the model are: Enhancement of designer creativity, Improvement of product quality, and Human resource management. The model is illustrated in Figure 12. It represents a theoretical framework aimed at improving product quality in computer design within domestic enterprises. Based on the presented model, it is evident that feedback and the information-gathering process are key components of the improvement process. The main elements include core business activities and processes; however, improvement depends on the feedback through which specific enhancements are achieved. The relationships shown between the main elements and the primary goal of the model are partially based on a review of the literature in the fields of computer design and human resource management. However, the main source of assumptions regarding these relationships comes from research involving CAD designers and customers.

The proposed model for improving product quality includes the main factors identified in the research conducted. As previously mentioned, these key elements are Customer Satisfaction (CS), Product Quality (PQ), Human Resource Management (HRM), as well as other present factors feedback (FIB) and competence (FIC).

Additional details on the core elements of the model are provided in Table 1.

Table 1: *Interpretation of model elements*

Number	Description
1	**Associative Orientation** – These individuals are imaginative, enjoy playfulness, have a multitude of ideas, and possess the ability to commit to a goal.
2	**Originality** – These individuals resist rules and conventions; they are different from others.
3	**Motivation** – These individuals are action-oriented, possess a focused and innovative mindset, as well as personal strength and willpower.
4	**Ambition** – These individuals strive to be influential, recognizable, and to attract attention.
5	**Flexibility** – These individuals can see things from different perspectives and develop various possible solutions.
6	**Emotional Instability** – These individuals tend to give in to negative feelings, experience mood swings, and have lower self-confidence.
7	**Lower Level of Sociability** – These individuals tend to be less attentive to their surroundings.
8	**Feedback:** This is the main "driver" of the improvement process. Information is collected from all elements of the model, and based on this information, necessary modifications and enhancements in the creativity of CAD designers are implemented.
9	**Enhancement of Digital Designers' Creativity:** This is the goal of the model. It is the result of integrating creativity with modern technologies.
10	**Information Gathering:** All feedback information is collected and analyzed.
11	**Correction and Modification:** Based on the collected and analyzed information, corrections and modifications are implemented.
12	**Product**: Refers to the products and services offered to consumers and customers.
13	**Employed CAD designers** play a key role in improving business activities and processes. They are the main agents of change.
14	**Quality**: Refers to the improved quality of the product according to consumer preferences.
15	**Customer** satisfaction is imperative, and CAD designers play a key role in achieving it.

Similar research can be found in the works of Bakator et al. (2019), who developed a model aimed at improving business operations and competitiveness of domestic companies in Serbia. The model yields significant insights into ways companies can optimize their operations and achieve competitiveness in the global market. In an earlier study, Bakator et al. (2018) developed a theoretical model that incorporates the implementation of Industry 4.0 technologies and a lean startup approach. Furthermore, Bešić and Bešić (2018) presented a model for applying marketing attributes that determine the competitiveness of domestic companies.

3.5.4 Suggestions and Guidelines for Enhancing the Creativity of Computer Designers

The literature review and the study of CAD designers' and customers' opinions provided the basis for proposing concrete guidelines to improve product quality.

The model was developed with the aim of providing an overview of how CAD designers—and consequently domestic companies—can improve the quality of their products.

Within the model, emphasis is placed on enhancing business performance and product competitiveness through improved quality.

Based on the findings in this field and the results of the research, the following guidelines are proposed to improve product quality in domestic companies: CAD designers should focus on customer relations.

Companies need to implement effective customer relationship management techniques to potentially increase customer satisfaction, which can, in turn, lead to improved competitiveness in the market.

3.5.5 Brand Development

To build customer loyalty, CAD designers must formulate effective product development strategies and implement with the overarching goal of enhancing customer satisfaction.

Improving product quality performance should be thoroughly analyzed, and where necessary, corrections and modifications should be implemented to gain control over how quality affects customer satisfaction.

Depending on the type of product, CAD designers should focus on providing a high level of personalization in the products they offer on the market.

The quality of operations, along with every aspect of computer design, should be standardized to ensure consistent levels of product quality. This approach encourages the implementation and application of a quality management system—specifically, ISO 9001.

When implementing ISO 9001 standards, CAD designers should focus on organic quality improvement, where certification is a byproduct of continuous improvement, rather than the main objective.

Continuous improvement in computer design is imperative for achieving long-term success in globalized markets.

Each CAD designer should be involved in changes that contribute to improving product quality and enhancing overall business performance.

Achieving competitiveness in computer design is practically difficult without innovation and the distribution of new products to the market. For these innovations to be effective, customer feedback must be analyzed and considered.

New and sophisticated products created by CAD designers will not improve business and market performance unless they are supported by well-designed pricing strategies.

When it comes to CAD designers, companies must develop a motivating work environment. The allocation of intellectual capital plays a crucial role in the development of new products and innovations in computer design.

The knowledge and skills of CAD designers should be periodically developed, which in turn increases their capacity for spontaneous innovation.

Domestic companies engaged in computer design must focus on quality, modern equipment, the use of ICT, and innovation.

The Government of the Republic of Serbia must create a motivating business environment for small and medium-sized enterprises (SMEs) engaged in computer design to help them become

more competitive. The government could reduce taxes and introduce incentive programs to encourage potential entrepreneurs to start their own businesses in the field of computer design.

4 CONCLUSIONS

In today's business environment, domestic companies in the computer design sector struggle to gain and maintain a competitive position in the local market. Their inability to compete effectively with firms from the European Union stems not from a lack of expertise among CAD designers, but from outdated production equipment, insufficient application of ICT, a lack of modern management tools and techniques, and, importantly, a demotivating economic environment.

This study analyzed the opinions of CAD designers working in domestic companies, as well as the opinions of customers regarding various products. The main objective of the research was to develop a model for improving the business operations and competitiveness of domestic companies in Serbia.

The research focused on product quality, customer satisfaction, and the application of innovation by CAD designers. Based on the findings, a model for improving product quality in computer design was developed. This model integrates measured factors and presents the relationships between its defined elements, providing clear insight into what these factors include and how they influence the improvement of product quality in the field of computer design.

In addition to these elements, the study found that originality, motivation, ambition, and flexibility have a favorable influence on business outcomes. These traits were shown to be strongly correlated with business performance and competitiveness.

5 LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The main limitation of this study lies in the fact that the developed model is based on data collected from CAD designers and customers in Serbia. As a result, the model is primarily applicable to the Serbian business and market environment.

The research was supported by a solid theoretical foundation. It incorporated existing theoretical frameworks and included a thorough literature review in the field of computer design. This literature review supports the validity of the findings and suggests that the results may be useful in similar economic and business contexts.

For future research, it is recommended that these factors be analyzed in other countries, whether within the European Union or in neighboring countries. The findings from such studies could then be compared with the results of this research.

This study makes a valuable contribution to the existing body of literature and provides a solid foundation for future analysis of relationships in the field of computer design, including the influence of originality, motivation, ambition, and flexibility, all of which impact the creativity of CAD designers and the improvement of product quality.

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