

Operationalization of Design Thinking in Business Intelligence and Analysis

¹V.S.Akshaya, ²Keerthana S, ³Philomina M, ⁴Pradeepa N R and ⁵Purnimah S V
^{1,2,3,4,5} CSE Department, Sri Eshwar College of Engineering, Coimbatore, Tamil Nadu.
¹vsakshaya@gmail.com

Article Info

A. Haldorai et al. (eds.), ^{2nd} International Conference on Materials Science and Sustainable Manufacturing Technology, Advances in Computational Intelligence in Materials Science.

Doi: https://doi.org/10.53759/acims/978-9914-9946-9-8_6

©2023 The Authors. Published by AnaPub Publications.

This is an open access article under the CC BY-NC-ND license. (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Abstract - In Information Systems research, the majority of early studies concentrate on applying the specific toolkit to produce Designing products and system to solve strategies, managerial, and operational challenges. Design Thinking has been effectively implemented in numerous domains. There is a minimal study on how Design Thinking may be supported in the context of business intelligence (BI) and also the analytics of business and integrated into the IS design-oriented aim to facilitate research (BA). How effective is Design Thinking facilitated in comparison to BI/BA to learn in a classroom setting, particularly in the proof-of-concept stage? How can it be integrated into the learning processes? Along with a guideline for the team involved in design thinking and the lessons acquired from each step of Design Thinking, a practical perspective on integrating the mentality and toolkit. As a case-based educational experience, it offers a design-thinking approach to the learning process. The findings of this study demonstrate that students may use Design Thinking techniques to frame their works and that these techniques are important alternatives for developing curriculum for teaching and learning.

Keywords –Design Thinking, Business Intelligence, Information Systems research, Social Innovation, Problem-Solving Practices

I. INTRODUCTION

Let us start by defining the differences between traditional analytics and data analytics. Although there is a difference, These terms are widely used in the same context. The technique of existing data analysis of delving into vast volumes of gathered data to derive conclusions and forecasts. Business intelligence and data analysis (also called business analytics) adopts that idea and extends it to the setting of business intelligence using preconfigured business information and tools that hasten the analysis techniques.

Alternatively put, the phrase "data analytics" broadly speaks of the current analytics process. As the total amount business analytics, which has a more concentrated approach, has grown in popularity as the amount of data has expanded functionally popular and meaningful to businesses all over the world. Cloud analytics technology is used by organizations merge information from multiple departments, such as sales, marketing, human resources, and finance, to create a unified view of how one department's performance affects the performance of others. You can make a collection of perspectives. Additionally, innovations in visualization, data modeling, and circumstance modelling offer a many different, original perspectives from the enterprise.

A sub-field of education known as "business education" focuses on imparting knowledge about company practices and procedures. There are several levels of instruction in this subject area, including secondary and advanced learning education. Business education majors play a crucial role in imparting the principles of business to high school and post-secondary students, who may one day go on to have successful jobs in the field or at least possess some astute business acumen. You will be qualified to instruct courses in accounting, word processing, business economics, and other topics after finishing the majority of Business Education programs.

These range from advanced management science and marketing courses pursued personal professional goals to typing and

computer classes pursued as part of degree programs (such as the master of business administration).

Business education courses are available at community colleges, universities, small private business schools, and professional and community organizations.

Business education programmers often focus on preparing students for real-life business scenarios and stress practical, utilitarian tactics and procedures for conducting business, with some theoretical topics being discussed especially in advanced courses for degrees. Business education programmers are often driven by market demands and trends, which determine the kind of coursework provided and their theoretical underpinnings. For instance,

in the 1990s, businesses placed a strong focus on cooperation, which prompted business school programmers to include lessons on management and collaborative work.

Design thinking is a methodical method of challenge that is based on a collection of skills. Despite the fact that the tactic has been used for some time, it was not until For the Harvard Business Review, Tim Brown, the CEO and president of the design firm IDEO, wrote an article titled "Design Thinking" in 2008 that it began to acquire popularity outside of the design community.

II. LITERATURE REVIEWS

Three Perspectives on Acting, Thinking, and Being Professionally

Robin et al., have proposed in this paper A framework for professional development as well as two speaking versions of this architecture widely to characteristics of "design thinking" provide the three perspectives for understanding design reasoning. The first lens employs a structure for "an actual conception of the professional" to describe how professionals arrange their knowledge and skills into a particular "professional manner of being activity." Examples of how to apply this paradigm to current findings from phonomyography research on how design and cross-disciplinary practice are experienced are given in the second and third lenses. We wrap up by talking about how these three perspectives help create a cohesive synthesis of design thinking and education.

An Educational Experience in Developing The "Preparing A Data Scientist" Big Data Analytics Course.

Daniel Adomako Asamoah et.al. has proposed in this paper In this piece, we offer a first-hand account of the huge data analytics course's methodology developed and taught to students at a prestigious institution in the Midwest. We created This program is grade 2.course in accordance with the MSIS 2006 Model Curriculum, including databases, computer programming, statistics, and data mining requirements. Students: Most students Seniors or graduate students who had a strong technical and mathematical background were in the class. foundation. We provide information on the subjects taught in the course; in addition tofour significant example course, assignments were summarized. Some of the ideas addressed include the administration and large-scale acquisition of data utilizing the Hadoop environment, stream social network analytics, visual analytics, and mining. The course includes Hadoop as well as outlined several Teradata and IBM big data technologies. We display how the training materials operate. Incorporate the course objectives and targeted learning outcomes. a completed course evaluation showed that the course's design and structure clearly and efficiently concisely absorb the course material.

Design Thinking as a Means of Citizen Science for Social Innovation

W. Tan et.al. has proposed in this paper Public or community members may contribute significantly to the creation of social innovations. Citizen science and social innovation come together when a social innovation is created that involves the community and a scientific methodology. It is possible to use design thinking in the establishment of social innovations. In this essay, We advocate using creative thinking as a strategy for combining the two disciplines to achieve the goal of bettering community life in Tokyo's aging housing complexes. Before introducing the design, and thinking process and examining its potential for involving citizens in social innovation, brief descriptions of the two domains of citizen science and social innovation are provided. The article offers two case examples and the conclusions reached from them. We end with advice for those who want to use this strategy. It's possible that society may evolve, and self-help may advance. and transformation if the community adopts the resulting innovation and design-thinking approach for future initiatives.

Digital Learning, Digital Science, Design Thinking

AnneBurdicket.al., have proposed in this paper Incorporating design thinking into projects for digital learning and digital scholarship is identified as a potential opportunity in this study. The study explores how the emergence of digital culture has prompted a reexamination of learning paradigms and a need for new forms of knowledge creation, driven by a variety of disciplines ranging from computer science to writing courses. The study makes the argument that projects like these are ideally suited for design thinking that is contextual, interpretative, and user-oriented by using case studies from new media education and the digital humanities. The report ends with a plea for design thinking research to interact with new models of knowledge creation and learning, work that might have long-lasting consequences on the development of knowledge.

A Language for Analyzing Discipline Crossings: Insights from Problem-Solving Practices In Technology:

Wolff, et al has proposed There is demand on lecturers to better understand the link between theory and practise, especially in sectors that rely heavily on technology, due to low graduate throughput and industry feedback that graduates are unable to handle the sophisticated techniques used in engineering "challenging issue" in the twenty-first century. The study examines several disciplinary organizing principles and their effects on intricate sociocultural activities using the Constitutional Act Specialization's conceptual component, which is based on the compassionate work of Basil Bernstein. This empirical foundation of the initial study is data acquired based on 18 research papers in engineering that were conducted in three different kinds of industrial practise contexts. To shed light on when disciplinary knowledge applies in

action, this research focuses on how a Word of Explanation might be used to specific stages of the issue method. Its goal is to provide.

Strategies And Effects of Teaching Universal Design in Cross-Facility Settings

Watchorn, V., Larkin, et al have proposed despite being a physical therapists and planners both possess a direct interest, universal design of built spaces isn't typically particularly included in the undergraduate curriculum. This study examines how students responded to the inclusion of universal design education in conceptual design and rehabilitation services programmers. The use of virtual and real-life simulation activities as well as online and in-person teaching approaches allowed students to experience impairment firsthand. The platform Second Lifetime was utilized for virtual simulation activities. The majority of pupils believed the materials and training activities were helpful, and the results indicated an increase as indicated by one's own learning results linked to universal design. It has been claimed that real-world simulations are more beneficial than virtual ones. The project's results encourage the inclusion of universal design education in occupational therapy and architectural courses and provide.

Introducing Design Thinking in Beginner Interdisciplinary Teams: Application and Limitations of Design Techniques and Reflective Practices

Seidel, V. P., et.al have proposed The advantages of employing techniques connected using a "influence on the development" methodology to creating new ideas have been covered in both academic and practitioner literature. Most research on the three basic design thinking techniques—finding, brainstorming, and prototyping—rely either on interviews with seasoned designers or look at each technique separately. Less experienced users will combine these strategies if design thinking is to be broadly accepted, but we don't know much about how they'll behave when first introduced. We gathered information based on opinions that see idea creation as basically composed of a divergent concept generating period marked by a converged concept selection phase, on 14 instances of novice interdisciplinary product development teams applying design approaches during both phases. Both the advantages and limitations of our hybrid qualitative and quantitative approach.

Business Analytics Related to Big Data: Research Roadmap

Phillips-Wren, G., et.al has proposed This study expands on talks from academia and business during the Special Interest Group on Decision Support Systems (SIGDSS) workshop and BI Congress III, two pre-ICIS conferences that took place in 2012 and 2013, respectively. Panelists at the two sessions talked about how firms may always using managing big data to your advantage realizing that it can provide fresh perspectives for innovation and decision-making. Expert panelists also assisted in identifying research gaps. The professional community is where the majority of the new developments are developing. even while increasing research in the academic community highlights some of the problems with gathering, interpreting, and exploiting big data. By establishing We strengthen the divide across both academic and practitioner research by using a big data analytics model that demonstrates a systematic approach of the components.

Towards A Broad Perspective of Information Systems

Nunamaker, J. F. Jr., & Briggs et.al has proposed On the sidelines of the Worldwide Conference on Data Systems in December 2009, some of the field's pioneers convened for a panel discussion to share their predictions for its future. Their remarks were condensed in the first issue of TMIS [Davis et al., 2010; J. F. J. Nunamaker et al., 1991]. They claimed that IS publication, events, reviewers, selection panels for positions, teachers, researchers, and curricula creators must enlarge the field of IS to ensure a strong future. The necessity for a bigger picture to guide the future growth of the IS field is examined in this essay.

Encouraging Cognitive Fluidity with Design Thinking: Strategies for Wider Application Of Studio Education In Higher Education

McLaughlan, R., & Lodge et.al has proposed Future professions will need to be more adept at teamwork, collaboration, and innovative thinking. Epistemic fluency has been proposed by Markauskaite and Goodyear as the educational approach must prepare graduates for more difficult problems (Markauskaite, L., and P. Goodyear. 2016. Epistemic Fluency and Professional Education: Innovation, Knowledgeable Action, and Actionable Knowledge. Springer). They have provided a paradigm for creating settings for epistemic learning, however they have not specified a method for carrying it out. The purpose of this work is to demonstrate the whole design studio useful educational model with a proven set of tactics for fostering epistemic fluency. It does this by drawing comparisons between epistemic fluency and design thinking. The applicability of the laboratory scenario will be used to enhance epistemic fluency. demonstrated through a series of experiments.

Determining The Impact of Contact Business Process Modeling

Lube, A., & Weskit et.al has proposed People may utilize the haptic toolbox we have developed to map and discuss their work processes. Cementitious business process modelling is the name given to it (t.BPM). Process modeling is a method

for visualizing goods for work, their ordering requirements, a data handled, and the persons accountable. Experts typically use software tools to develop these models. When the model is constructed, domain experts are questioned but remain quiet. For modeling, our method makes use of a set of chalkboard markings and plastic tiles. By doing this, we influence beginner users' decision-making task planning. We made progress toward the answer over the first year. Even though we are confident that our strategy produces improvements, scientific research was still lacking.

Design Thinking: A Fertile Concept for It Development?

Lindberg, T., Menial et.al has proposed Partnership Innovation in IT Sector Development Processes as our research topic, and we are interested in How idea generation might help increase the level of innovation in IT development and what organizational and individual characteristics might support or promote this. This section explores the potential contributions of design thinking to technical thought and how it pertains to pertinent IT development. methodologies (such as agile development), and what our preliminary findings on the consequences for instruction and organizations are. The fact that it is not always simple to comprehend what this phrase genuinely implies seems to be the nature of the design. As the first quotation reveals, those who work in design have a different perspective on themselves as well as a better understanding of their field.

Recognition, Acceptance, And Implementation Of Design Thinking In The It Industry

Lindberg, T., Köppen et.al has proposed In recent years, addressing the social elements of IT solutions has emerged as a key differentiator in the IT marketplaces. IT development is being compelled to put a greater emphasis on that very non-technical and user-centered components of design issues. In light of this, a new conceptual framework for IT development has been proposed and put to use: design thinking. We analyze What creative awareness in an IT environment entails setting in our research project, which is based on case studies, qualitative interviews, and analysis. We describe the benefits of design thinking over conventional IT design paradigms as well as the challenges associated with understanding, putting into practice, and embracing design thinking in the IT development process. Professionals with extensive training and the ability to handle complicated situations are required for IT development procedures.

We see both positive and negative effects from the combination of linguistic exercises that results. When it prompts introspection and raises an understanding of the boundaries and limitations of conventional IT design methodologies, it is beneficial. In regards to carrying out and embracing design thinking, it can be detrimental since a risk that share similar meanings degrade the concept's causality test and ultimately dissolve it into a "semantic nirvana." It is not unexpected that our respondents sought to eliminate the hazy overlaps between both realms, either by splitting them into two distinct worlds or by fusing them together to form one cohesive universe. universe since implementation and acceptance demand precise notions. Our respondents attempted to clarify the guidelines governing language games using both approaches.

Enabling Lean Design Thinking: Software Product Development from Empathy to Delivery

Hildenbrand, T., & Meyer et.al has proposed A few years ago, it seemed like everyone in the business was discussing how "Lean Thinking" would enhance software development. Lean Thinking, in conjunction with agile process frameworks, evolved as best practices, books were produced, and it eventually started to seem like the norm in software development. Lean and agile development is now widely used, so people are beginning to ask what "Design Thinking" is all about. We commonly are asked if Design Thinking will eventually replace lean software development whenever we provide development team mentoring at a sizable software business. We conclude that Design Thinking is not the same as Lean successor; rather, There may be several relationships seen between two schools and greatly benefit from one another. This is based on our experience leading multiple teams through successful projects.

Design Considerations for Decision-Makers: Discover It System Alternatives

Frisk, J. E., Lindgren et.al has proposed the focus of the literature has typically been on how rational conduct, organizational politics, and structured anarchies are employed to make decisions. However, research on managers' decision-making as a creative process find and weigh options is scarce. By suggesting a design strategy to change organizational decisions, we close this gap. The strategy believes that managers may use their imagination and adaptability to make decisions iteratively gather and analyze disparate pieces of information, experiment with various hypotheses, and identify and assess potential solutions. Although the strategy is built on the expertise Its fundamental design attitude helps managers to better consider the needs of the relevant actors comprehend potential solutions via analyses of both organized and unstructured data.

Design Thinking and Organizational Culture: A Review and Framework for Future Research

K. D. Elsbach and Stigliani et al. proposed A problem-solving method known as "design thinking" which employs tools commonly adopted by individuals who develop products, systems, and settings that may be sold commercially (e.g., designing a new car or the layout of a new airport). And even though creative thinking was first promoted as a tactic that was most effective as it was incorporated into a work success, the vast majority of early studies on this subject was conducted outside of the organization on learning the specific methods and tools that may be used to handle significant challenges. The relationship between organizational-level factors like organizational culture and the use of creative

thinking has only recently been studied by researchers. In this study, we look at empirical research—mostly from the last ten years—that demonstrates a connection between the integration of systems thinking and corporate culture development.

The Impact of Real-Time Business Intelligence and Advanced Analytics on Decision-Maker Behavior

Chen, H., Chiang, R. H. L., & Story, A. has proposed that even though there are numerous tools available to assist leaders, organizational decision-making processes are nevertheless prone to prejudice and mistakes. One strategy to help managers make educated, evidence-based business choices is business analytics (BA). BA initiatives continue to fail despite significant funding. Researchers have shown that managers need knowledge to make judgments, while other studies have found that business decisions are frequently based on gut instinct and intuition, ignoring some or all of the data and information that is available. The authors of this study tested the hypothesis that receiving information at the same moment a business choice is being made might affect or modify the decision maker's perspective and result in a different conclusion. The study adds to the descriptive.

III. EXISTING SYSTEM

There are three levels of sentiment analysis. Levels of documentation, sentence levels, elements [7] and levels. Emotion recognition at the word level looks at the actual document and categorizes its polarity. Sentence-level sentiment analysis based on sentence polarity. The sentiment generated by each element of a target entity is discovered through integral part sentiment analysis. Cue et al. proposed a double propagation approach for sentiment analysis based on aspects. By using syntactic relationships, this technique extracts the aspect expression and emotion. Between target audience and opinion, words to spread them to a framework for creating a business intelligence (BI) system that can extract the relationship between customer ratings and reviews has been developed. Two data mining methods were used by the program to autonomously extract the judgment value; consequently, it is possible to comprehend the relationship between rating and review manually. A few procedures must be taken to develop a BI system. In the first stage, called feature extraction, all features composed of textual data are taken. Phrases that appeared in the review and extracting it. These properties are filtered since not all terms—aside from a few key terms—are necessarily taken. Using TF-IDF, this word selection procedure is carried out. The next step is to locate the review's decision-making guidelines. Association rule mining and rough set theory are the methods employed in this study (RST) solution for business intelligence analysis of customer sentiments via Twitter. To create three-dimensional data, OLAP and data cubes undertake opinion analysis (product name, date, polarity). For each product on a specific day, the algorithm calculated the frequency of tweets to provide a report.

IV. PROPOSED SYSTEM

Business intelligence is created through the ETL (Extract, Transform, Load) process, aspect expression extraction, aspect aggregation, and business intelligence. The recommended system's architecture is depicted. Module for extracting expression aspects 1. Sentiment and the module for extracting expression aspects. This module establishes the feeling orientation for each pair of aspect and sentiment pairings. Double propagation is the approach used to extract the aspects in **Fig 1**.

- Identification using POS-Tags
- Identification of dependency relations
- Extracting the aspects and expanding the various opinions on the word-dictionary
- Determining the opinion words' polarity and the intended extraction outcome
- Eliminating extracted targets

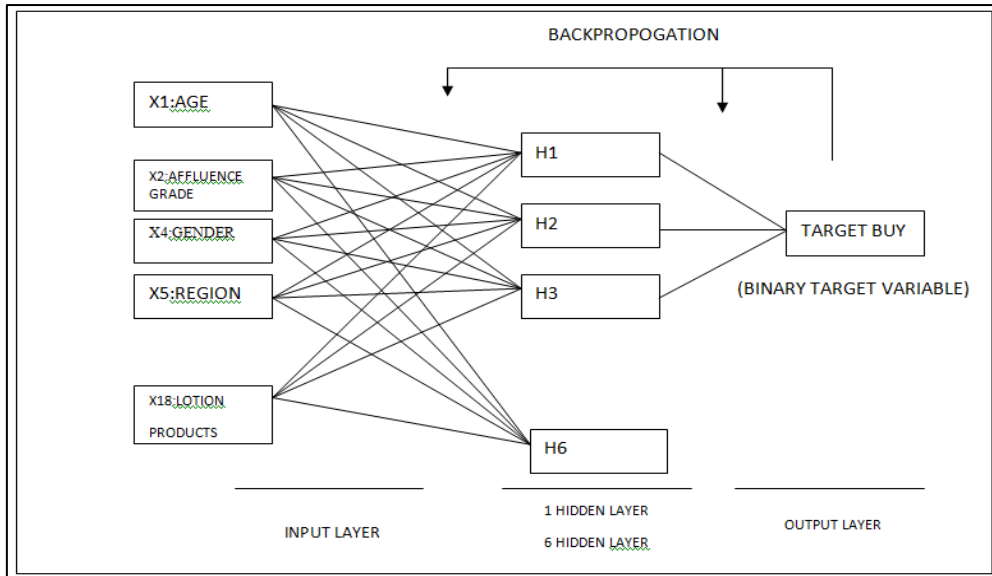


Fig 1. Sentiment Pairings

The retrieved aspects are grouped into specific aspect categories using an aspect aggregation module. The process of aspect aggregation involves determining how similar each seed—which stands for a particular aspect category—is to the aspect expression. The data preparation and processing are done by an ETL (Extract Transform Load) module. ETL is the process of transferring large amounts of data for business analysis from a source to a database [10]. The transaction data were combined in fact and dimension tables during the ETL process. Aspects of expression and opinion word extraction provided the transnational data used in this study. Previously, data was stored in Jason's files.

The An expressive thinking and sentiment extraction project overview that is graphically exposed, is displayed using the business intelligence module. The business and the data intelligence's objective, namely: What the player thinks of the game, inform the design of business intelligence. Building a multi purpose model is required to organize the idea of a new multifunctional table, which is then provided regularly, to provide answers to the previously raised concerns. The multidimensional model, namely the star schema fact aspect, is shown in Figure 4. Seven dimensions are present: the opinion dimension, the goal dimension, the orientation dimension, the category dimension, the sentence dimension, the review dimension, and the date dimension. The F-Measure (Fig 2) for aspect aggregations makes it easier to see and gain insight, The ETL procedure modifies the acquired expression aspect extraction, which is then placed in a series of layers. The following are the components of the insight. They are the comparison of good and negative emotions, the player-favorite element category, and the aim that must be taken into account while building a game.

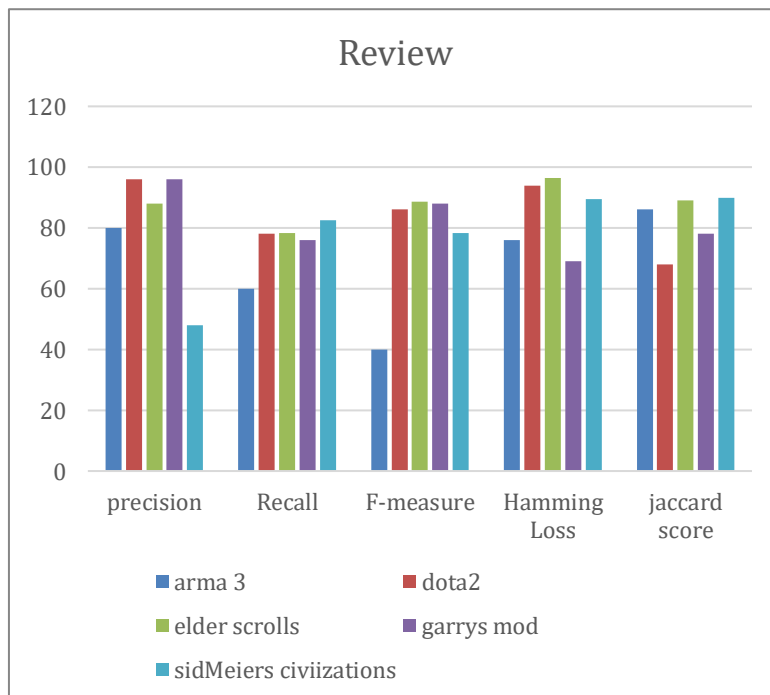


Fig 2. F-Measure for Aspect Aggregations**Table 1.** Visualization

| expression | precision | Recall | F-measure | Hamming Loss | Jaccard score |
|-----------------------|-----------|--------|-----------|--------------|---------------|
| arma 3 | 80 | 60 | 40 | 76 | 86 |
| dota2 | 96 | 78 | 86 | 94 | 68 |
| elder scrolls | 88 | 78.4 | 88.6 | 96.4 | 89 |
| Garry's mod | 96 | 76 | 88 | 69 | 78 |
| sidMeiersciviizations | 48 | 82.5 | 78.4 | 89.5 | 90 |

The data is represented visually using **Table 1**, with the design of the visualization tailored to the specific goals of business intelligence. The resulting visualization provides valuable insights to decision-makers.

V. CONCLUSION

The study illustrates how Design Thinking may be facilitated the cognitive skills in layout IS research, particularly in the context of enterprise intelligence and analytics endeavors. The mentality and toolkit of the Design Thinking method may be creatively applied to gather user demands and analyze user challenges, and both researchers and practitioners can benefit from using Design thinking for innovative solutions in BI or BA projects serving as proofs of concept. The findings of this study demonstrate that students may use Design Thinking techniques to frame their works and that these techniques are important alternatives for developing curriculum for teaching and learning. To bring ideas to life, the Design Thinking team must work in cooperation with users throughout the iterative process. The five design thinking stages listed in this study are not usually sequential and occur in a straight line. For instance, many Design Thinking teams may discover after testing the prototypes that they did not frame the problem appropriately and must redo the Design stage again and update their POV. In reality, both creating the prototypes and testing them might generate fresh ideas for the projects. Prototyping helps generate new ideas to tackle problems. The achieved representational aspect extractions are modified by the ETL process and stored in a multidimensional model for easy visualization for insight. Insights consist of: They are a comparison of positive and negative emotions, categories of aspects that players prefer, and goals to consider when designing a game. Future studies will investigate other methods to obtain better performance. Additionally, you can gain more insight by using the game developer's internal data (such as sales) when building business intelligence. B. Whether the features selected the competition's sales may boost because of the analysis's findings.

Reference

- [1]. Akshaya, V., et al. (2016). Business Intelligence as a Service in Analysis. *International Journal of Applied Engineering Research*, 2(4), 2458-2467.
- [2]. Sathyanarayanan, M. (2019). Post-Doctoral Fellowship (PDF) in the area of Cybersecurity. CEO of MIT SQUARE, London.
- [3]. Haldorai, A. et al, eds., 2018. *Cognitive social mining applications in data analytics and forensics*. IGI Global.
- [4]. Anandakumar, H et al, 2019. Computational intelligence and sustainable systems. *EAI/Springer Innovations in Communication and Computing*.
- [5]. Prasanna, et al, 2021, March. Data Validation and Migration-A Theoretical Perspective. In *2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)* (Vol. 1, pp. 1540-1543). IEEE.
- [6]. Adams, R.S, et al, 2011. Being a professional: Three lenses into design thinking, acting, and being. *Design Studies*, 32(6), pp.588-607.
- [7]. Asamoah, D.A., et al, 2017. Preparing a data scientist: A pedagogic experience in designing a big data analytics course. *Decision Sciences Journal of Innovative Education*, 15(2), pp.161-190.
- [8]. Brown, T., et al, (2010). Design thinking for social innovation. *Development Outreach*, 12(1), 29–43.
- [9]. Burdick, A., et al, (2011). Digital learning, digital scholarship, and design thinking. *Design Studies*, 32(6), 546–556.
- [10]. Wolff, K. (2018). A language for the analysis of disciplinary boundary crossing: Insights from engineering problem-solving practice. *Teaching in Higher Education*, 23(1), 104–119.
- [11]. Watchorn, V, et al, (2019). Strategies and effectiveness of teaching universal design in a cross-faculty setting. *Teaching in Higher Education*, 18 (5), 477–490.
- [12]. Seidel, V.P. and Fixson, S.K., 2013. Adopting design thinking in novice multidisciplinary teams: The application and limits of design methods and reflexive practices. *Journal of Product Innovation Management*, 30, pp.19-33.
- [13]. Phillips-Wren, et al(2019). Business analytics in the context of big data: A roadmap for research. *Communications of the Association for Information Systems*, 37(1), 448–472.
- [14]. Nunamaker, Jr, J.F. and Briggs, R.O., 2012. Toward a broader vision for information systems. *ACM Transactions on Management Information Systems (TMIS)*, 2(4), pp.1-12.
- [15]. McLaughlan, R. and Lodge, J.M., 2019. Facilitating epistemic fluency through design thinking: a strategy for the broader application of studio pedagogy within higher education. *Teaching in Higher Education*, 24(1), pp.81-97.
- [16]. Lindberg, T., et al (2018). Design thinking: A fruitful concept for its development? In C. Meinel, L. Leifer, H. Plattner (Eds.), *Design thinking*. Berlin, Heidelberg: Springer, pp. 3–18.
- [17]. Lindberg, T, et al 2012. On the perception, adoption, and implementation of design thinking in the IT industry. In *Design thinking research* (pp. 229-240). Springer, Berlin, Heidelberg.

- [18]. Hildenbrand, T., & Meyer, J. (2019). Intertwining lean and design thinking: Software product development from empathy to shipment. In A. Maedche, A. Botzenhardt, L. Neer (Eds.), *Software for people*. Berlin, Heidelberg: Springer, pp. 217–237
- [19]. Frisk, J. E., Lindgren, R., et al(2019). Design matters for decision-makers: Discovering IT investment alternatives. *European Journal of Information Systems*, 23(4), 442–461.
- [20]. Chen, H., Chiang, R. H. L., &Storey, V. C. (2019). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, 36(4), 1165–1188