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INNOVATION MANAGEMENT APPROACHES: DESIGN VALUE CALCULATOR GAMIFICATION

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Abstract: *Design is a specific form of complex innovation that affects all areas of an organization's management. However, the essence of design is vague, and it is difficult to fully grasp the concept of design. Therefore, it is difficult to find criteria for determining its value. The problem of establishing a causal relationship between design value and user experience is addressed in this paper. The relationship between these two variables affects the importance of design in organizations and can be used to quantify the value of design. Indeed, based on the results of existing research, it is known that this term has many meanings, and it is necessary to reject the possibility of its total quantification. Much of the related research has focused on the area of user experience and customer value, while other related research has focused on design value, which cannot be measured directly but rather, for example, through system dynamic modelling. This approach,* i.e.*, the use of a system dynamic model to determine the value of design, is still missing in the research literature. The main research method for determining the value of design is the experimental method, supported by other research methods: modelling and structured questioning. Inputs to the model, which represent the opinions of the company's managers on the design, are obtained through a board game that provides an attractive and easy-to-understand user interface for the research participants. The value of design is determined by using a sample case study that contains key variables according to the company's business model. The value of the design is calculated based on the indicator "design cost-effectiveness" over six years of the start-up company's business. The indicator is experimentally verified in a model with an identical structure and different scenarios concerning the involvement of design change in the economic development of the firm. This paper aims to use the gamified DVCG model as an innovative concept in business management through a case study. The contribution of the paper to science and practice is to provide experimentally validated evidence to help identify the areas where design investments are needed to make the most sense for the economics and management of the organization.*
Keywords: business model; design management; design value; gamification; multiple case study; system dynamics; innovation approaches.

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1. Introduction. Design drives growth and development, efficiency, prosperity, innovation, and competition. Design is an important part of solutions that are created for users, which are solutions that save the environment. We can find these powerful statements in the Montreal Design Declaration (2017). Design is a specific form of complex innovation that reaches all areas of an organization's management. The design process relates to human behaviour and experience. It can result in various products, in addition to business models. Companies that use design and design methods strategically in product development gain new business opportunities. This results in increased competitiveness (Danish Design Centre, 2018).

The design drives growth, exports, and productivity. Design influences the prosperity of organizations and national economies and has significant social, cultural, economic, and environmental impacts on sustainability. Design is central to the culture and experience economy, which, according to the Danish Design Centre (2018), is one of Denmark's main areas of economic growth. According to the Danish Design Centre (2018), the more design is used systematically in organizations, the greater its value. The design is an essential parameter of competitiveness in the next five years (Danish Design Centre, 2018). Design management is increasingly important, mainly because the customization of products characterizes the current market. Users are more interested in brands associated with values and unique experiences (OECD, 2017). Therefore, choosing the right strategy is a new challenge for designers, design management, and C-Suite firms. Whether a strategy for improving design in an organization is right or less right can be determined only through systematic measurement.

The issue of design value is part of every product, either directly (i.e., its functional features, aesthetics, distribution, and brand) or indirectly, in the form of well-designed marketing methods, customer relationships, and internal processes within the organization. If the value of design is so significant, as the research shows, we must also be able to measure it using predetermined criteria. However, the design of these devices is complex, and because the devices are nebulous, these criteria are difficult to apply. This article offers one possible approach to the measurability of the value of design.

Some research points to problems in determining the value of design. According to The National Agency for Enterprise and Housing (2003), design is a comprehensive concept and therefore cannot be used to quantify the total design quality. The research (BCD Barcelona Design Centre, 2014) states that a firm's value creation depends on many factors, the development of a firm is dynamic, and the development of a firm's prosperity is nonlinear. The value of design cannot be determined without linking it to the business model of the firms studied. Nevertheless, we found research projects in the literature that calculate the value of design. The closest to this paper's published concept is McKinsey's research (Sheppard et al., 2018). This company created a questionnaire that calculates the McKinsey Design Index (MDI) based on the responses of the research participants. The design definition in this survey is about understanding user needs and then developing products that satisfy human needs. According to Sheppard et al. (2018), growth and long-term performance are the top management priorities of companies. After completing the questionnaire, McKinsey automatically sends the resulting report, which includes the calculated MDI, the participating organization's ranking in the quartile according to the calculated index, and two resulting graphs of potential revenue growth in percentage terms. The first outcome chart sets out the forecast improvement in revenue for a company moving from the final quartile (as measured by the self-assessment test) to the fourth-best quartile. The second outcome chart shows the projected annual growth in total returns to shareholders (TRS) based on the MDI score and the annual growth in TRS in the top quartile of MDI performance.

The research on the value of design in this paper draws on the BCD Barcelona Design Centre (2014), Sheppard et al. (2018), and National Agency for Enterprise and Housing (2003) and shows how we can determine the value of design while avoiding linear simplification. Understanding the causal relationships and linkages between system elements is critical to strategic decision-making. Corporate managers need to understand the possible causes and effects of such events. In this paper, the board game is a comprehensible concept for moving from critical systems thinking to a system dynamic model. Thus, the board game creates a reliable user interface for understanding the cause and effect of managerial decisions. The board game also allows us to predict who will win the game—based on the layout of the playing pieces on the board—before calculating the value of the design in the system dynamic model. In that case, however, these are only guesses by the game facilitator; only the system dynamic model and a rigorous interpretation of its results will provide accurate results and design value dynamics. The aim of the game interface is to explain to all participants (research participants) the complicated relationships between variables in the model, which is ideally the digital twin of the organization's business model. Therefore, the board game helps players (company managers) understand the mechanisms by which a company creates value through the contribution of design.

Motivating the emergence of board games to establish the value of design is a core of education (Boghian et al., 2019; Neves, 2021; Chukusol & Piriyasurawong, 2021) that identifies positive student and teacher attitudes toward these types of games. The primary goals of these games in education are as follows:

1. Increasing students' motivation to learn.
2. Improving learning effectiveness through discussions among players.
3. Reducing the need to learn complex system concepts without understanding the essence of these concepts.
4. Promotion of critical thinking, teamwork, and communication

There are many benefits to playing board games and using them in the classroom, and teachers like to use them when appropriate. Therefore, consultants in executive coaching firms have recently begun to explore the potential value of using game design to improve managers' skills (Boghian et al., 2019). Games are systems in themselves that consist of several interconnected elements. These elements include rules, game goals, stories, and other game attributes. Playing a game requires players to consider how these elements relate to each other. Using games as models of other systems, therefore, offers extraordinary opportunities to understand the complexity of the relationship. The user interface for selecting input data for the model is a user-friendly structured questionnaire for qualitative research. It is comprehensible as an input database for system dynamics modelling and will help to understand the mechanisms by which a firm creates value.

The main objective is to apply the design value calculation game (DVCG) as an innovation concept in the management of a company using a case study as an example. The research data collection tool was adapted into a board game: the design value calculator. This tool collects data from research participants (business leaders) in a structured way because design is the intersection of functional, distributional, social, and emotional experiences of a product user. The value of design was established in a system dynamics model of the organization.

2. Literature Review. According to Pavlou (2013), design is a complex process involving aesthetic and functional aspects of a product. Moreover, design is also a part of marketing (Cropley & Cropley, 2005) and can be implemented in organizational processes (Edquist & Hommen, 1999). "The economic benefits of design change depend on the role that design plays in the overall innovation process". (The BCD Barcelona Design Centre, 2014). Design is a critical factor whose activities bring ideas to the market and transform them into quality and valuable products (Meyerhoefer & Zuvekas, 2008).

2.1 Gamification as a Tool for Better Education Ludic epistemology (De Castell, 2011) refers to the fact that educational games can partially replace traditional (linguistically mediated) epistemologies. Ludic epistemology's main problem is how to encode knowledge in games and how we might use the play process in learning new concepts. Boghian et al. (2019) mentioned game education behavioral and constructivist learning theories. Other types of games are based on the principle of "drill and practice" and use quizzes, points, and clicks (Zalka, 2012; Rugelj, 2015; Rugelj et al., 2018). Problem-based games help students build appropriate mental models (Rugelj, 2015). The neurophysiological use of games based on constructivist learning theories generates changes in how the teacher intervenes. The teacher plays a more discrete teaching role; its impact is mostly formative and problem-oriented and can be in the form of coaching players/students. According to Boghian et al. (2019), the authors of a recent review of the board game literature (Willet et al., 2018) identified several benefits of board games in education: games provide opportunities to improve persuasion and rhetorical skills (Bogost, 2010). In addition, games provide problem solutions and lessons to learn (Squire, 2011) and are helpful in solving real-life problems (McGonigal, 2011). Games strengthen collaboration among participants and promote innovation through learning (Parjanen and Hyypiä, 2019). Board games are a viable solution in adult education. They allow students to bond and be motivated to remain engaged in learning with and from others. The Design Value Calculator board game creates a platform for thinking about a company from the perspective of its management. Players can learn by trial and error without risk, gaining experience in a simulated environment. Each game has its own story, expressed through a creative scenario. This board game simulates the process of economic development of a company over six years of business. The players' decision-making is based on peer discussions in five strategic areas:

- Product or goods innovation.
- Service innovation.
- Marketing methods innovation.
- Customer relationship innovation.
- Innovation of the organization's internal processes.

Thus, the game aligns with the publication concepts of the BSC (Parkman, 2021) and Sheppard et al. (2018). Explaining the role of design in the firm through a board game is visually appealing and simplistic so

that the player grasps the essence during the game and can then apply it in other decision-making in the firm's practice. The design value calculator board game directly encourages interactivity between players who search together for situations that are closest to the players' experience.

2.2 Design Value as a Nonmeasurable Unit. Currently, no empirical evidence can demonstrate that the economic value creation contributed by a design change has a linear progression where the results are directly proportional to the input investment (BCD, Barcelona Design Centre, 2014).

According to the Frascati manual, the relationships between variables and their dynamics are derived. If a single value cannot be used to measure the design, it can be measured against an appropriate dynamic frame of reference. Thus, it will not be a static number but rather the evolution of the design over a predetermined time. System dynamic modelling fully meets such requirements. Therefore, if we cannot measure the design statically, we can measure it dynamically. This model consists of feedback loops, levels, and flows. It is essential to understand and track dynamic models that explain the role of design in the economic value creation process. For this reason, it is necessary first to compile a model of the organization. In this case, we can test different scenarios that measure the impact of a design change on economic value creation. The value of design is a dimensionless category, which corresponds to the requirement for a dynamic conception of the design category that must consider the relationship between firm economics and design investment. This proposed conceptualization is consistent with the BSC model (Parkman, 2021) and is in line with McKinsey's (2022) model of measuring design potential.

3. Methodology and Research Methods. The value of the design was determined using the experimental method, which we supported by other research methods: modelling, multiple case studies, and structured inquiry. To explain the research methods, a questionnaire is used as a user interface for inputting values into the model: the board game "design value calculator". In this way, it is possible to gain the interest of players/managers as research participants so that they understand the complexity of the design concept. The correctness of the system dynamic model cannot be fully validated or verified (Sterman, 2000) because the claims supplied by the model can neither be supported by objective truth nor verified. However, we can test the model for its behavior's sensitivity and unit consistency. We chose the method of using extreme values to test the sensitivity of the model's behavior. However, we achieved a certain degree of verifiability of the model: we consistently tested the model for the correctness of the financial statements according to double-entry bookkeeping principles. We balanced assets and liabilities at each step of the model. We obtained this principle of equality in the balance sheet based on the economic behavior of the organization model.

Using multiple case studies as a research methodology allows researchers to analyse several related cases and produce a summary interpretation. Studying complex phenomena, such as social systems (business models), which consist of many different components, is useful. It is essential that the model is easy to understand. We achieved this with the help of a board game whose elements form a system view of the design, and the values set by the game are the input data to the model. According to Osterwalder & Pigneur (2010), the BMC, clarity is also significantly enhanced by Osterwalder's well-known concept.

The empirical research method (Ochrana, 2019) presented in this article induces conditions deliberately set by the researcher. The experiment aimed to find an answer to the question under artificially created (induced) conditions. An essential element of the experimental method is the iterative approach, which alternates among various parts of the research design (Kapiszewski et al., 2015; Fairfield & Charman, 2017). In the experiment, we combined qualitative questioning of the research participants. Deaton and Cartwright (2018) noted that the correct choice of an experiment as a research method depends on the questions we asked at the beginning of the research and our prior knowledge (Saunders et al., 2018). We met two critical conditions for choosing a research method experiment: the model solves a specific problem, and the researcher has relevant experience for modelling in Vensim.

The paper contributes in the following areas:

1. Design value is defined as a specific category that can be quantified with the help of an experiment.
2. This shows how the value of design can be determined even if it is a dynamic category and not a static quantity.
3. A user-friendly interface is set up to understand the complexity of the design concept. We use the user interface we designed like a board game. We used the design value calculator game to obtain input data for a system dynamic model.
4. This paper demonstrates the advantages and limitations of the design value calculator board game and its application in developing critical thinking skills in a team of players.

This paper defines the objective and the main research question, subobjectives, and subresearch questions as steps that contribute to the solution of this research problem. The value of design is difficult to define and

measure. "Design is difficult to isolate as a function, and the design function operates differently by industry." (DMI: Design Management Institute, 2015). This scientific problem has not yet been sufficiently addressed. The research methods of experimentation and modelling are new and have not been applied to address the problem of determining the value of design. The result of the solution is also original in its approach, which is a board game as a communication map for structured questioning of research participants and comprehensible determination of input data to the SD model.

Research Hypothesis: The DVCG will enable a company to predict measurable outcomes of a design investment.

Main RQ (RQM): How can the measurable value of design be determined by the conditions of the organization under study?

SC1: Define design as a complex category.

SRQ1: How can a questionnaire (like a board game) help research participants understand the complexity of the design concept? How can we visualize the different data that go into the model? How can the input data be understood by research participants (C-Suite)?

SC2: The design value must be a dynamic indicator that calculates the design's impact on the firm's economics over a specified period.

SRQ2: How can we determine the value of design when the effect of design on a firm's profits is not linear and when the results are not directly proportional to the input investment?

3.1 Experimental Design and Sequential Steps in Research. The beginning of the research method experiment to determine the value of the design was dated to 2020. During 2021 and 2022, we further researched different organizations: nonprofit organizations, public administration organizations, companies, and universities. The following section describes the specific steps for using the experiment in research to determine the value of the design. We deliberately broke down the steps to achieve the necessary transparency of an iterative approach to the research method of experimentation.

In the first step, we conducted a preliminary literature search. The literature analysis showed that the contribution of design could be measured with aggregate data and macroeconomic indicators (National Agency for Enterprise and Housing, 2003; Benton et al., 2018). However, we cannot measure design value in an individual company. Design value is a dynamic variable that changes over time and is linked to the economic performance of organizations (BCD Barcelona Design Centre, 2014). Parkman (2021) noted that despite increasing attention, design management still needs to be a traditional conceptualization or widely accepted empirical measure of the construct. DMI: The Design Management Institute (2015) argues that the value of design is more difficult to measure than is the traditional ROI indicator.

In the second step, we built a model of the start-up company in Vensim. Based on a literature review, we propose a system dynamics model for a start-up firm (Cosenz, 2017). We set exogenous variables that enter the model and correspond to a specific case study (a small startup company with a turnover of up to 1 million CZK per year dedicated to refurbishing old bicycles and converting them to electric bicycles). The design value calculator is a tool for obtaining input values about the design into the model. First, we obtain the dimensionless coefficient of the design value algorithm (Svirakova & Kramolis, 2021). The mental model, which considers the firm's entire business plan, incorporates the impact of innovation (by design) using the design value algorithm (DVA) coefficient on the customer segment and indirectly on all other business model segments. The impact of design can have both progressive and regressive effects on a firm's economic performance. The model for measuring the value of design is built on the Osterwalder & Pigneur (2010) concept (see Fig. 1).

The default system dynamics model consists of 60+ feedback loops. The PROFIT variable is crucial for calculating the design value. The system dynamics model obtains variables from the "design value calculation". We prepared four different profit scenarios for the model:

- no design change (zero option);
- based on managerial decisions;
- optimal decision making;
- the worst decision.

Step 3 started the collection of qualitative data using a structured questionnaire (design value calculator). During subsequent interviews, the survey was gradually modified to ensure that the managers' responses captured the data needed for the system dynamics model. Interviews were conducted with managers of 90+ companies. The PROFIT indicator was vital for determining the value of the design. However, as shown in the subsequent iterations, this indicator was not objective (due to the strong influence of the initial UX value).

Its expression in monetary units was also problematic. In this third step, a document was created to record the responses using numbers.

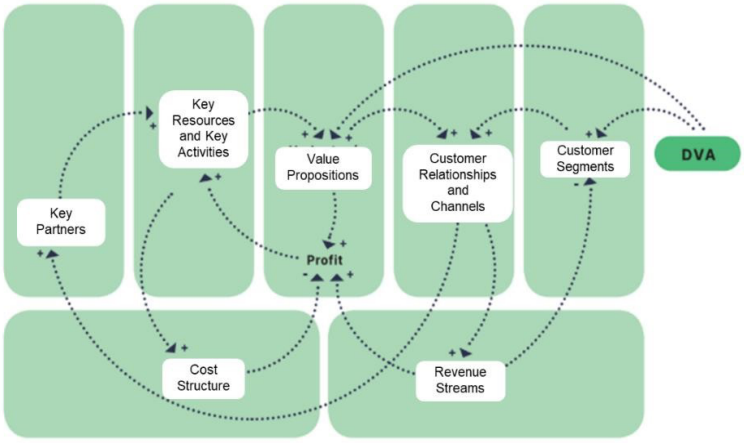

Figure 1. Business Model for System Dynamics Model
Sources: developed by the authors based on Osterwalder & Pigneur (2010).

Refining the approach of measuring design value and the firm model was necessary for the subsequent progress of the research (step 4). In this iteration, the indicator for determining the value of the design was changed to a dimensionless coefficient: design cost efficiency. The conditions create playing the game and determining the winner with the best strategic thinking. A decision was made about the degree of influence of different emoticon colours on the input data to the model, with the red colour indicating an angry smiley lifestyle changing the participants' answers the most.

We carried out the data analysis in step 5, and we further tested that. We played the game several times, with individuals competing against each other. The shortcomings of individual player involvement became apparent in this preliminary test in a larger group. There was no space for discussion because each player made decisions about his business because he could not discuss with any partner. Therefore, we created a team version of the game. The team thinks about the design of the same company; each player chooses one area of innovation for the chosen company. Team members can discuss the perceived value of the design by users of the firm's products. In this team version of the game, the personal form of the final decision was also maintained. Therefore, a player may disagree with the opinion of most team players and make a different decision than other team members. The results of the players of the cooperating team are then aggregated and compared with the aggregated results of the other teams.

According to constructivist learning theories, the last step, number 6, for playing any game is very important because players need to be sure who won or lost and why. Therefore, analysing conversations about the value of design, i.e., analysing players' decision-making, is critical. We discussed the game's outcomes with the players/managers not only during the game but also after the game. We rewarded the winning team.

4. Results. The published studies revealed a problem with the value of design determination, which cannot be measured directly but rather through other economic categories. Figure 2 shows the modelled profit development of six identical firms over six years of business. The PROFIT curves in the figure all have the same shape and are visible only as a single curve in the computer-generated model. For clarity, the curves in the figure below have been shifted to be visible in the graph. The Vensim program has the following limitation in the version used: more than six curves and six different waveforms of any dynamic indicator (in this case, PROFIT) cannot be displayed in one graph. The progression of the profit curves is shown in the graph (Figure 2). The flow of the graph is without design and without using the UX (user experience) variable. Therefore, the "null version" of the six case studies is used to verify the correctness of the model.

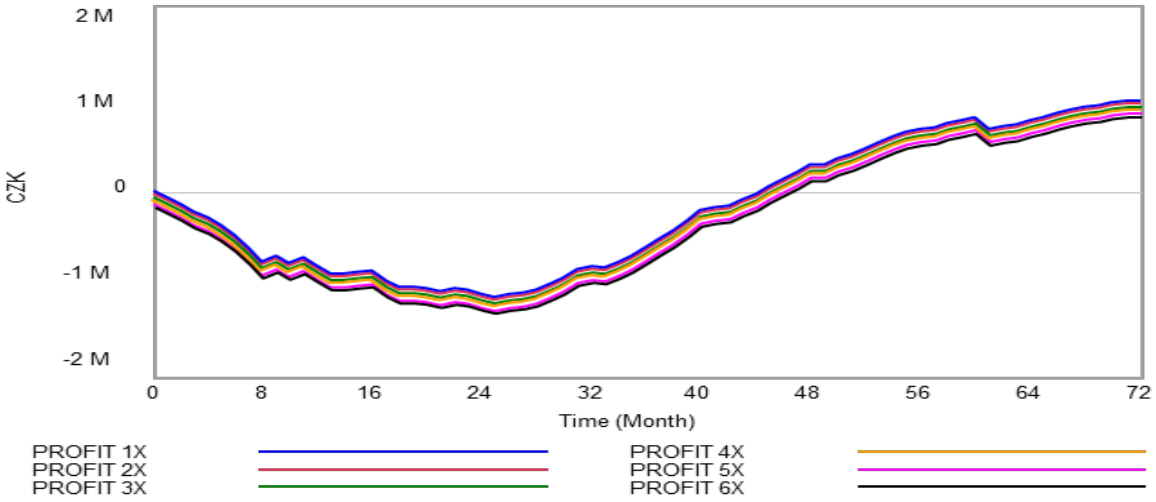

Figure 2. PROFIT 6 Case Studies with the same business algorithm without design and UX
Sources: developed by the authors.

4.1 Business Algorithms in the Dynamic Business Model Canvas. If design creates value, then this value is always related to the customer as a consumer of value. A rational consumer measures two variables: the satisfaction of the needs that the product will bring and the cost of the product. The rational producer, in simple terms, has similar constraints: he must have sufficient cash flow to allocate to the creation of new value. In doing so, one must consider all the costs involved in developing the firm. However, business is a complex system that cannot be described in simple terms. A business model must be created to solve a predefined problem. Modelling is not the goal; it is the solution to the problem. The model of the firm must simplify the reality that defines the problem. The model is, therefore, only a tool for achieving this goal. The model is a simple but consistent and balanced business model of a start-up company.

4.2 Quantitative Evaluation of Design Value Calculator data: case study. The research data are collected using the design value calculator, which forms the framework for the structured interviews. User experience is calculated from the following variables: UX = User Experience; C = Competitive advantage, i.e., Comparing the researched organization with its competitors; and CAG = (Customer Action Goals), that is, how the client (research participant) estimates customer expectations.

This calculation shows that UX can theoretically take values from zero to 100. The smaller the ratio between the competitive advantage and the customer action goals is, the more it makes sense to invest in design in that area (leverage). In other words, the smaller the customer experience is, the more important it is to invest in the area, thus increasing the chances that the customer will be more interested in the product offered. The customer experience is calculated for four design dimensions:

- (x1) what the product looks like;
- (x2) how the product works;
- (x3) how quickly and well the product is shipped;
- (x4) How the customer is perceived by their social group.

Description of the variables in the formula for calculating DVA: P = Points by decision; I = Importance of the decision; D = Influence of designers.

The parameter [D] means that we have to include collaboration with designers in the design value calculation. Kramolis (2017) states that collaboration with designers is vital for firms. There are an increasing number of managers who did not collaborate with designers in the past. This change can be interpreted as firms attaching more importance to design and being aware in a highly competitive environment that design can be a competitive advantage. It is therefore necessary to have an expert in this area.

All the parameters obtained through the design value calculation questionnaire are applied in the formula. The design value algorithm (DVA) indicator is also influenced by the decision of the research participant (company manager). The DVA indicator is dimensionless. The higher the DVA is, the more worthwhile it is to invest in design because the management decision corresponds to the need to improve any UX parameters in a specified order of importance. The deciding points determine the client's strategy. Design resources involve collaboration with designers on the choice of strategy. The situation can be expressed as 1, 1.1, 1.2, or 1.3.

The computed design value algorithm (DVA) is attached to the customer segment element in the system dynamic model. An example of the completed design value calculation is shown in Figure 3. The business model of the firm operates in four scenarios:

- Firm value development without design involvement;
- Firm value development with design change – player's own decision;
- Firm value development with design change –the best/ideal decision in a given situation;
- Firm value development with design change – worst/least appropriate decision in a given situation.

DVA affects the customer segment, and through this element from the business model canvas, all other parameters, including PROFIT accumulation.

The case study illustrates the completion of the design value tool, the design value calculator. It shows how we can obtain valuable data and insight from the management of organizations on different parts of their business in a game (DVCG).

The design value calculation (Figure 3, left) shows a filled playing field. To make the results easier to understand, not only for the game facilitator but also for the players, each player transcribes their answers into a table (Figure 3, right). However, it is not only about these numbers; the discussion between the players as research participants or between the players and the game facilitator is also valuable.

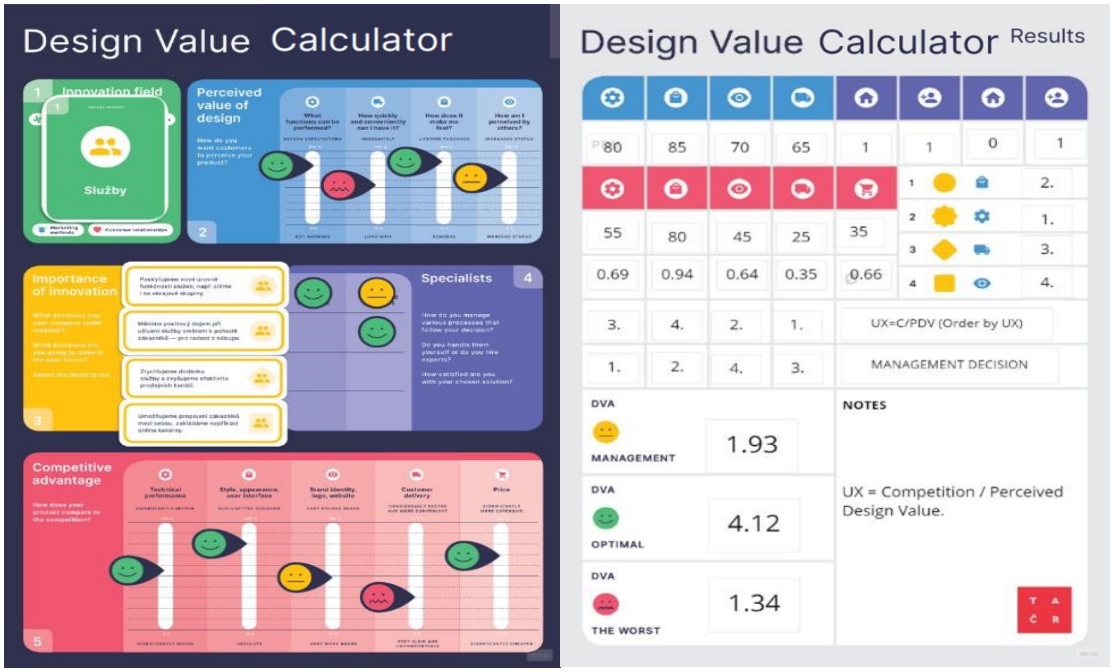

Figure 3. Design value calculation game (DVCG). Experimental case study
Sources: developed by the authors based on (Svirakova, 2021).

Table 1 shows the UX and D calculations calculated by the design value calculator. The table also includes an example of emoticon color processing. In the Customers Action Goals (CAG) calculation, responses are multiplied by the appropriate percentage; in the Competitive Advantage (C) calculation, responses are divided by the appropriate percentage.

Table 1. Case study: UX

Design area	CAG	C	UX=C/CAG	D
Appearance	85	80	0.94	1.3
Function	80	55	0.69	1.1
Distribution channels (red emoticon)	54×1.2=65	30/1.2=25	0.38	
Brand (yellow emoticon)	64×1.1=70	50/1.1=45	0.64	

Sources: Developed by the authors based on the design value calculator

Table 2 below shows the managerial, optimal and worst decisions and the calculation of DVA as a dimensionless impact factor of design investment.

Table 2. Dimensionless coefficient calculation for the design value algorithm

No.	Behaviour pattern (scenarios)	Client's (research participant's) choice	DVA
1.	Pattern (scenario) without design	-	1
2.	Client behaviour pattern (scenario)	(1.) function; (2.) appearance; (3.) distribution channels; (4.) brand	1.93
3.	Optimal behaviour pattern (scenario)	(1.) distribution channels; (2.) brand; (3.) function; (4.) appearance	4.12
4.	The worst behaviour pattern (scenario)	(1.) appearance; (2.) function; (3.) brand; (4.) distribution channels	1.34

Source: Developed by the authors based on Tab. 1 and the design value calculation formula.

The DVA calculation is not understandable for the C-Suite. Therefore, finding a result based on the same calculation but speaking C-suite is very useful. We must take advantage of C-Suite Management's understanding of the numbers and graphs that show the development of economic indicators. Therefore, in the next section of the paper, three graphs are shown to help determine the benefit of the design in four model situations.

4.3 Design value measurement results for four different scenarios. The following steps are iterative processes by which the game facilitator corrects, tests, and analyses the experimental model during data collection. PROFIT is an appropriate accumulation that demonstrates the value of the design. All four design decisions compare very well within a single firm and a single player (Fig. 4).

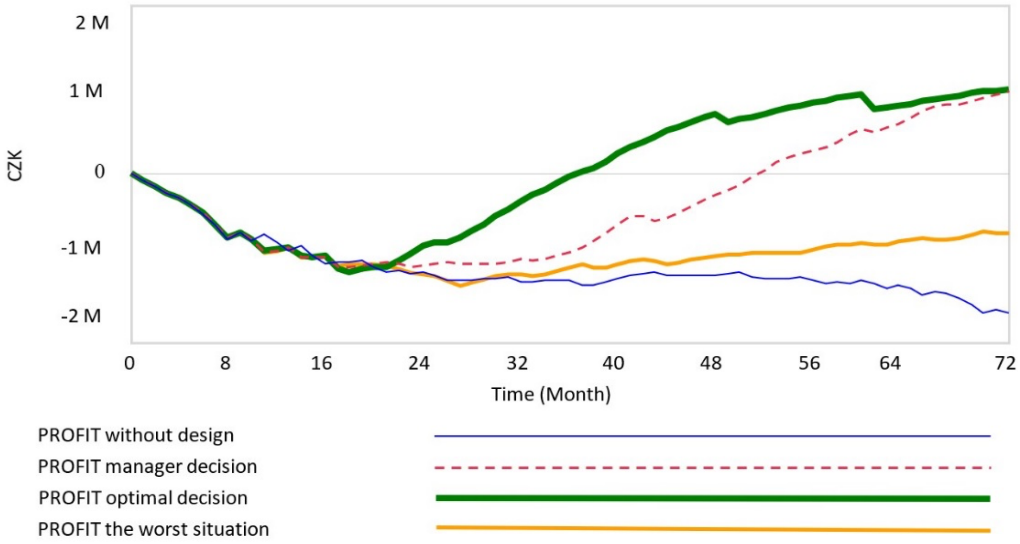

Figure 4. Illustration of dynamic behaviour (PROFIT)
Sources: developed by the authors.

The value of the PROFIT indicator is given in monetary units, and the initial UX influences its course. Therefore, it is not suitable for measuring the value of design. The most appropriate variable is "Return on Design Cost". It has the advantage of being dimensionless and accounting for all costs of product innovation in design. The design cost profitability indicator expresses how many currency units of profit the company has gained by investing one currency unit of cost. Therefore, the design cost profitability indicator measures the degree of efficiency with which costs have been spent. The value of this indicator should be as high as possible and should increase steadily during development, as the enterprise should try to achieve the highest profit at the lowest cost.

In Fig. 5, we can see the difference between a manager's decision (red curve), the path of the cost-effectiveness curve under the optimal decision (green curve), and possibly the path of the same curve under the worst-case scenario (yellow cost-effectiveness curve). All three curves correspond to the situation expressed in the Design Value Calculator (Figure 3). Figure 5 shows that although the manager's decision is not optimal, the rate of return on design costs increases until the end of the fifth year of business. After that, it begins to stagnate. Under these conditions, the profitability of the optimal decision peaks 24 months earlier

in the company. The DVA coefficient was greater than 1 even in the worst case, so this scenario (yellow curve) is also useful in the game (business).

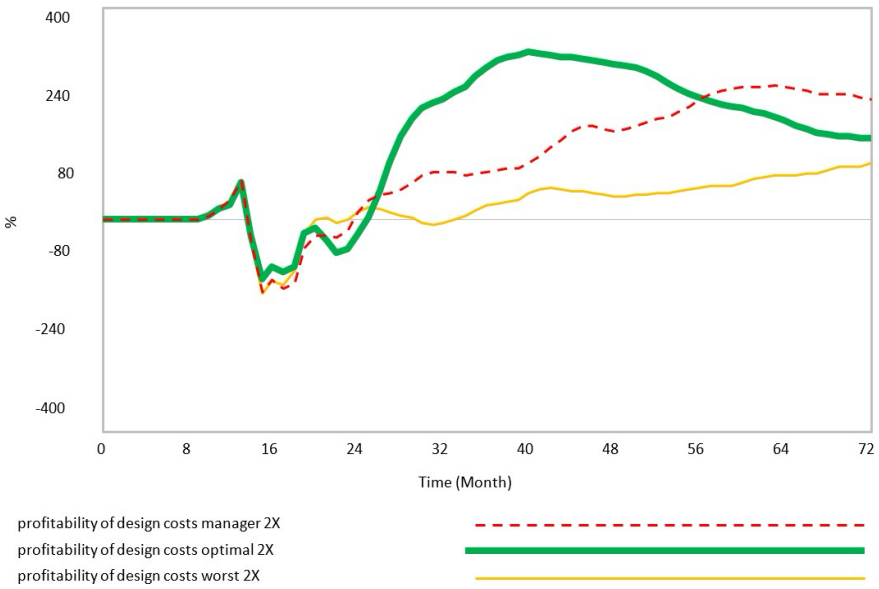

Figure 5. Visualization of the profitability of design costs
Sources: developed by the authors.

We can compare the decision-making of the player (case study 2X) with that of the other five players (case study 1X, 3X – 6X); see Fig. 6. Case study 2X is the red curve; according to the managerial decision, the player is ranked 4th if we focus our attention on the 48th month of business (red curve case study 2X, Fig. 6).

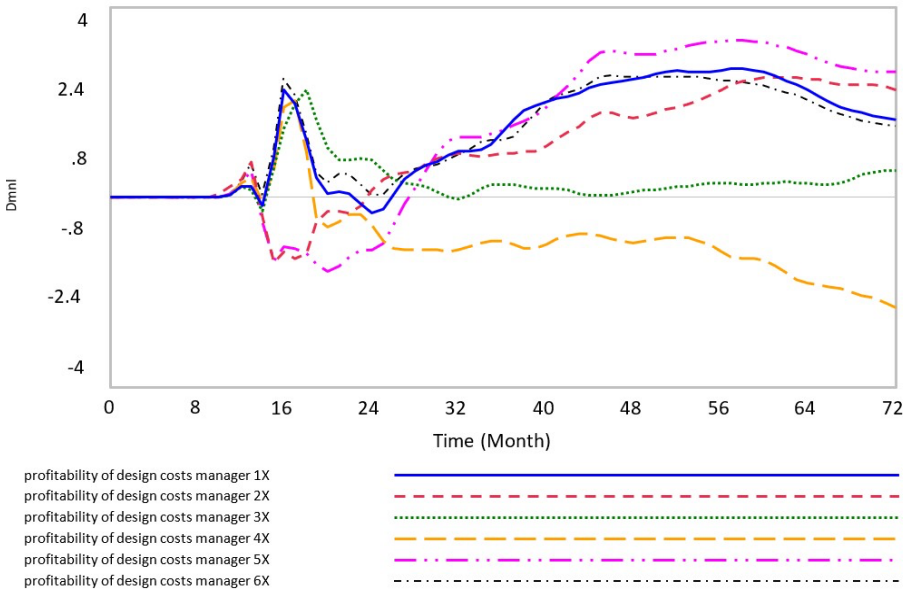

Figure 6. Profitability of design costs for 6 case studies: Management decisions about design
Sources: developed by the authors.

4.4 Answering Research Questions and Confirming the Hypothesis The main objective of the present research is to use the gamified DVCG model as an innovative concept in business management through a case study.

Main RQ (RQM): How can the measurable value of design be determined by the conditions of the organization under study?

The value of design can be determined using a system dynamics model if the economic performance of the organization is modelled. Two index-like parameters are first determined: UX, User Experience; and

DVA, Design Value Algorithm. The UX parameter strongly influences the design value. However, the design value is not influenced by the price parameter. Therefore, it is shown that we can determine the value of design under the conditions of any organization under study (companies, nonprofit organizations, public administration organizations, and others that cannot price products by selling price). We can also determine the value of design for subparts of the organization and for subdevelopment projects within the organization, including internal projects.

DC1: Define design as a complex category.

DRQ1: How does a questionnaire in the form of a board game help us understand the complexity of the design concept? How can the different data that go into the model be visualized? How can the input data be understood by research participants (C-Suite) who do not use dynamic modelling software?

To convince C-Suite management that design pays, and that good design means good business, we need to speak the C-Suite language while offering a user-friendly solution. Input to the more complex calculations is provided by the design value calculator, which is visually appealing and offers an element of competitiveness. Individuals and entire teams can play, always competing for the best strategic solution in the company. C-Suite expects a clear calculation result and a compelling argument for changing the way we think about design. They need a clear answer to why they should include design at the beginning of the innovation process. The parameters they fill in on the design value calculator help to do this. The board game allows them to think about product innovation, innovation in marketing methods, internal processes, and customer relationships. The user experience is four-dimensional: functionality, emotional experience, product distribution, and company brand. The board game is a design element; it evokes emotions and the desire to win, thus changing the thinking about design as a strategic economic category. A board game can offer understandable inputs to a model that cannot be challenged or manipulated because it is built on the experiment. In this paper, an experiment is a purposefully induced trial that accurately determines the profit evolution of the model organization under specified conditions. An experiment set up in this way cannot be fooled. The only barrier is incorrectly determining the input data to the model situation from the players and the research participants. The design value calculator defines design as a comprehensible communication map, and the system dynamic model accurately calculates the value of design according to the specific situation of the company under study. The complexity of the concept of design can be better understood with the help of a board game canvas.

DC2: Determine the value of design as a dynamic indicator that evaluates the impact of design on the economics of the firm over a specified period.

DRQ2: How can we determine the value of design when the effect of design on a firm's profits is not linear and when the results are not directly proportional to the input investment?

The value of a design can be determined by one indicator, the design value algorithm (DVA). However, the design value set this way is incomprehensible to the C-Suite. The value of design is closely linked to the economic performance of organizations, so it is appropriate to use system dynamics modelling of corporate business development.

The following hypothesis is confirmed: DVCG will enable the company to predict measurable results from design investments. The dynamic indicator that best determines the value of design in a given situation and under given conditions is the cost-effectiveness of design. The validity of this hypothesis is demonstrated in a case study.

5. Discussion. "Design is often regarded as a soft parameter—on par with human resources and marketing—which is difficult to quantify since its mechanism cannot be defined in isolated terms. While marketing within the last 10–15 years has been granted individual status in company accounts, the economic benefits of the design are still difficult to identify owing to the comprehensive nature of the activity." (National Agency for Enterprise and Housing in Denmark, 2003).

Assuming that the value of design is correctly determined and optimized, two perspectives emerge: one from the consumer/customer's perspective (satisfying their needs) and the other from the company's perspective (generating revenue by understanding and recognizing the customer's needs) (Svirakova, 2017).

Research by DMI: The Design Management Institute (2015) showed that it is impossible to find standardized metrics for design because the meaning of design varies from industry to industry. The Design Council (2022) states, “Design shapes the world. It has enormous power and with that comes responsibility. Different design values are often overlooked because, on the whole, they have not historically been the primary objective of design. They are also varied, difficult to assess and aggregate into a single metric, unlike the pound sign, and sometimes difficult to attribute wholly to a single design. McKinsey states that design is

a CEO-level priority for growth. The gap in quantifying the value of design as mentioned by DMI: Design Management Institute; BCD Barcelona Design Centre is filled by the method DVCG.

McKinsey's research (2022) is the closest to the research results presented in the paper. After completing an online questionnaire, McKinsey automatically sends the resulting report, which includes the calculated McKinsey Design Index (MDI), the organization's position in the quartile according to the calculated index, and two resulting graphs of potential revenue growth in percentage terms. The first chart sets out the company's forecast of revenue improvement when moving from the final quartile (as measured by the self-assessment test) to the fourth-best quartile. The second graph shows the projected annual growth in total returns to shareholders (TRS) based on early MDI and the annual growth in TRS in the top quartile of MDI performance.

Despite these limitations (DMI: Design Management Institute, 2015; Design Council, 2022; Danish Design Centre, 2018), a measurement metric that determines the economic value of design is iteratively created through an experiment, a system dynamics model of the firm, and structured questioning with visually appealing elements (Board Game Design Value Calculator). The paper demonstrates that the value of design can be determined. The design's value is positive if customers' saturation with the company's products is not fulfilled or is only partially fulfilled. The value of design is negative if the customer is satisfied with the company's products and does not require further innovation in the form of design in a given situation. The design value algorithm coefficient (DVA) is a parameter that captures the design concept in its entirety and calculates its value based on this definition. Within each company, the value of this coefficient varies and is determined based on the research. The resulting DVA is incorporated into the system dynamics model. Since the design is considered from the customer's point of view, the DVA coefficient affects the "customer segment" building block of the model (Svirakova & Kramolis, 2021). All the other building blocks of the business model are affected by this element (Osterwalder and Pigneur, 2010). The value of the design is determined by contributing the calculated static DVA coefficient using the dynamic variable Profitability of design costs over the six modelled business years in the system dynamic simulator. The model's property is internal integrity; the model behaves the same way, and the resulting calculation affects only the decision-making of the players/managers of the firm. Additionally, the optimal or least appropriate decision is an optimum/pessimism only with respect to the player-specified UX input value. The correctness of the calculation is guaranteed by the experiment, which the model supports. The integrity of the model is guaranteed for all types of companies, namely, large enterprises, SMEs, nonprofit organizations, public administration organizations, and partial innovation projects.

Although it is not possible to fully validate or verify the accuracy of a dynamic model, there are ways in which the reliability of its outputs can be defended. The main argument for the unquestionability of the result is the algorithmic way in which the design value in the model is calculated. The inputs depend on the research participants' assessment of the situation in the firm. Once the inputs are given, the result is always calculated in the same algorithmically way for all given scenarios. Thus, the correctness of the results depends on proving the correctness of the model structure since the structure of the dynamic model determines its behaviour.

We can verify the structure of the model by two basic methods:

- consistency of units.
- keeping the double-entry accounting principle consistent with the real situation of the firm.

According to Sterman (2000), the consistency of the units of a model is one of the basic tests of the correctness of the model and is one of the first to be performed in the model. During the insertion of each new variable, units were always added. The inconsistency of units is checked by the model; the function "Units check" is built into the model. This function does not detect any errors when the modelling is run.

The system-dynamic model by Cosenz (2017) was extended to match as closely as possible the real situation. According to Sterman (2000), testing starts with the first equation written. The simulated behaviour of the model is compared to the actual behavior of the real system. The concepts in the real world must be identical to the concepts in the system dynamics model. Therefore, the model by Cosenz (2017) has been extended to include specific levels, flows, and auxiliary variables to balance liabilities and assets. This means that with each step in the model, for each calculation, the liabilities and assets of the organization are equally and equally burdened. The model is therefore fully compliant with the principles of double-entry bookkeeping, which means that its structure is set up correctly and that the outputs in the form of graphs are reliable.

System dynamic modelling is not a tool that can provide objective truth. The model must be created to solve a predefined problem. Thus, the model is only a tool for achieving this goal. The model must simplify the reality that defines the problem to be solved. The tools of system dynamics make it possible to create control simulators—microworlds in which space and time can be compressed and slowed down. In this way,

models can help us understand complex systems and develop strategies to improve the well-being of organizations.

6. Conclusions. A clear, attractive, and accurate way to obtain input data for a system dynamics model is the board game design value calculator. This paper aims to use the gamified DVCG model as an innovative concept in business management through a case study. The team version of the game allows one to take advantage of the benefits of board games: an engaging, nonthreatening, but competitive atmosphere; unintentional learning; linking information; and promoting critical thinking, reasoning, and communication in teams. The game strategy, which includes questions, problems solving, and challenging situations, forces players to engage in critical thinking, problem solving, and systems thinking and allows them to think about the practical problems of a company they know well. The Design Value Calculator board game turns abstract concepts into concrete products, encouraging the acquisition of concepts that would otherwise be difficult to understand. The DVCG is based on a case study that represents the story of a start-up company over the first six years of business.

Nevertheless, determining the design's value does not avoid the risk of distortion of the input data. During the interviews, players estimated customers' perceptions of the current value of the design according to four parameters: the product's functionality, its aesthetic level, its distribution, and the company's brand. Suppose the manager does not know how customers perceive the product. In that case, he or she can express this in the questionnaire using an emoticon (a yellow and red emoticon that affects the numerical expression of the player's answer). However, in practice, i.e., outside the game environment, the path to more accurate data is much more complicated.

A system dynamic model that informs the value of design over the six years of an experimental firm's business can be used in multiple problem domains. Further research will focus on measuring ROIs in innovative internal process designs. Inputs will, therefore, affect not only the customer segment but also the key resource areas and key activities on the business model canvas.

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References

BCD Barcelona Design Centre (2014). Design - Measuring Design Value: Guidelines for collecting and interpreting design data. [Link]

Benton, S., Miller, S., & Reid, S. (2018). The Design Economy 2018: The state of design in the. Design Council. [Link]

Boghian, I., Cojocariu, V. M., Popescu, C. V., & Mâţă, L. (2019). Game-based learning. Using board games in adult education. *Journal of Educational Sciences & Psychology*, 9(1), 51-57. [Google Scholar]

Bogost, I. (2010). *Persuasive Games: The Expressive Power of Videogames*. 2rd. USA: MIT Press.

Chukusol, C., & Piriyasurawong, P. (2022). Development of Flipped Classroom using Cloud-Based Learning and Board Games Model to Enhance Critical Thinking Skills. *TEM Journal 11(1),* 94–103. [Google Scholar] [CrossRef]

Cosenz, F. (2017). Supporting start-up business model design through system dynamics modelling. *Management Decision*, 55(1), 57-80. [Google Scholar] [Link]

Cropley, D. H., & Cropley, A. J. (2005). Engineering creativity: A systems concept of functional creativity. *Creativity across domains: Faces of the muse*, *1*(15), 169-185. [Google Scholar]

Danish Design Centre (2018). *Design Delivers 2018, How design accelerates your business*. [Link]

De Castell, S. (2011). Ludic epistemology: What game-based learning can teach curriculum studies. *Journal of the Canadian Association for Curriculum Studies*, *8*(2), 19-27. [Google Scholar] [CrossRef]

Deaton, A., & Cartwright, N. (2018). Understanding and misunderstanding randomized controlled trials. *Social science & medicine*, *210*, 2-21. [Google Scholar] [CrossRef]

Design Council (2022). Design Economy People, Places and Economic Value. [Link]

DMI: Design Management Institute (2015). Design Value. [Link]

Edquist, C., & Hommen, L. (1999). Systems of innovation: theory and policy for the demand side. *Technology in Society*, 21(1), 63-79. [Google Scholar] [CrossRef]

Fairfield, T., & Charman, A. E. (2017). Explicit Bayesian Analysis for Process Tracing: Guidelines, Opportunities, and Caveats. *Political Analysis,* 25(3), 363–380. [Google Scholar] [CrossRef]

Kapiszewski, D., MacLean, L. M., & Read, B. L. (2015). *Field research in political science: Practices and principles.* Cambridge University Press. [Google Scholar]

Kramoliš, J. (2017). *Design management in companies in the Czech Republic*. Zlín: Tomas Bata University.

McGonigal, J. (2011). *Reality is Broken: Why Games Make us Better and How They Can Change the World.* New York: Penguin Books. [Google Scholar]

McKinsey (2022). McKinsey Design Index. [Link]

Meyerhoefer, C. D., & Zuvekas, S. H. (2008). The shape of demand: what does it tell us about direct-to-consumer marketing of antidepressants?. *The BE Journal of Economic Analysis & Policy*, *8*(2). [Google Scholar] [CrossRef]

National Agency for Enterprise and Housing in Denmark. (2003). Economic Effects of Design.

Ochrana, F. (2019). *Methodology, methods and methodology of scientific research*. Prague: Charles University, Karolinum Publishing House

OECD. (2017). Guide for local government, communities and museums. [Link]

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers* (Vol. 1). John Wiley & Sons. [Google Scholar]

Parjanen, S., & Hyypiä, M. (2019). Innotin game supporting collective creativity in innovation activities. *Journal of Business Research*, 96, 26–34. [CrossRef]

Parkman, I., & Malkewitz, K. (2021). "Good Design is Good Business": An Empirical Conceptualization of Design Management Using the Balanced Score Card. *Design Management Journal*, *16*(1), 66-77. [Google Scholar] [CrossRef]

Pavlou, V. (2013). Investigating interrelations in visual arts education: Aesthetic enquiry, possibility thinking and creativity. *International Journal of Education through Art*, *9*(1), 71-88. [Google Scholar] [CrossRef]

Rugelj, J. (2015). Serious computer games in computer science education. *EAI Endorsed Transactions on Game-Based Learning,* 2(6), 150613. [Google Scholar] [CrossRef]

Rugelj, J., Jedrinović, S., & Bevčič, M. (2018). A comprehensive model of a cooperative role-playing game. Ljubljana: University of Ljubljana. [Link]

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., ... & Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity*, *52*, 1893-1907. [Google Scholar]

Sheppard, B., Sarrazin, H., Kouyoumjian, G., & Dore, F. (2018). The business value of design. [Link]

Squire, K. (2011). *Video Games and Learning: Teaching and Participatory Culture in the Digital Age. Technology, Education--Connections (the TEC Series)*. Teachers College Press. 1234 Amsterdam Avenue, New York, NY 10027. [Google Scholar]

Sterman, J. (2000). *Business dynamics: systems thinking and modelling for a complex world*. Irwin/McGraw-Hill.

Švirakova, E., & Přidalova, K. (2021). *Umíme změřit, proč se vyplatí investice do designu*. [Link]

Švirakova, E., & Kramoliš, J. (2021). Case study: Design value measuring by system dynamics. *E a M: Ekonomie a Management*, 24(3). 79-92. [Link]

Willet, B. S., Moudgalya, S., Boltz, L., Greenhalgh, S., & Koehler, M. (2018). Back to the gaming board: Understanding games and education through board game reviews. In *Society for Information Technology & Teacher Education International Conference* (pp. 495-503). Association for the Advancement of Computing in Education (AACE). [Google Scholar]

World Design Summit Organization (2017). Montreal Design Declaration. [Link]

Zalka, C. V. (2012). *Adventures in the classroom creating role-playing games based on traditional stories for the high school curriculum.* (Doctoral dissertation, East Tennessee State University). [Link]

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Підходи до управління інноваціями: гейміфікація калькулятора цінності дизайну

Мета цієї статті полягає в використанні графічної моделі DVCG як інноваційного концепту в управлінні бізнесом. Дизайн є конкретною формою складної інновації, яка впливає на всі аспекти управління організацією. Проте сутність дизайну є неоднозначною, і важко повністю впровадити концепцію дизайну у практичну сферу. З огляду на це складно знайти критерії для визначення його вартості. У цій статті розглядається проблема встановлення причинно-наслідкового зв'язку між цінністю дизайну та користувацьким досвідом. Взаємодія цих двох змінних впливає на важливість дизайну в організаціях та може бути використана для кількісної оцінки його значення. На основі результатів існуючих досліджень визначено, що дизайн – це термін, який має багато значень, що ускладнює уніфікацію процесу його повного кількісного оцінювання. Більшість відповідних досліджень сконцентрована на сфері користувацького досвіду та корисності для клієнта, тоді як інші – зосереджені на цінність дизайну, яке не може бути безпосередньо виміряне, а, наприклад, через моделювання системної динаміки. Такий підхід, тобто використання моделі системної динаміки для визначення значення дизайну, ще відсутній в досліджуваній літературі. Основним методом дослідження для визначення цінності дизайну є експериментальний метод, який підтримується іншими методами такими як: моделюванням та структурованим опитуванням. Вхідні дані для моделі, які відображають думки керівників компанії щодо дизайну, отримано за допомогою настільної гри, яка надає привабливий та легкий для розуміння інтерфейс для учасників дослідження. Цінність дизайну визначено за допомогою зразкового випадкового дослідження, яке містить ключові змінні згідно з бізнес-моделлю компанії. Цінність дизайну розраховано на основі показника ефективність цінності дизайну протягом шести років діяльності стартап-компанії. Цей показник експериментально перевірено в моделі з однаковою структурою та різними сценаріями щодо включення зміни дизайну у економічний розвиток компанії. Внесок статті в науку та практику полягає в тому, щоб надати експериментально підтверджені докази для визначення областей, де потрібні інвестиції в дизайн для отримання максимальної ефективності в управлінні компанією.

Ключові слова: бізнес-модель; управління дизайном; значення дизайну; гейміфікація; багатократний випадкове дослідження; системна динаміка; підходи до інновацій.