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*Advances in Business-Related Scientific
Research Conference - Abstracts*

*Advances in Business-Related Scientific
Research Conference - Papers*

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KEYNOTE SPEAKER



Dalibor Vukovič

Dalibor Vukovič is a PhD candidate in Cybersecurity and a product manager at Telekom Slovenije. He is a cybersecurity specialist and ethical hacker with several internationally recognized certificates. He has more than 20 years of work experience in the ICT sector. He is involved in the development and implementation of new security products in both the private and public sectors, including the largest work organizations, critical infrastructure and state institutions. He is the author of several articles and contributions at professional conferences and a lecturer in the field of cybersecurity. His research interests include OSINT methodology and prediction of cyber attacks.

Abstract

A When Cyber Attack Becomes Reality: Live Hacking Show

Join us for an exciting presentation where we will conduct a live cyber attack on a company and reveal how quickly hackers can breach your system. Follow the steps of the attack, from initial information gathering using OSINT, to phishing, and the final takeover of critical data. This presentation is not just about watching an attack - it's a wake-up call that will show you how vulnerable your systems can be and how quickly a compromise can happen. Experience the real world of cyber threats that could hit your organization tomorrow, and learn how to protect your company from these dangers. Don't miss this unique opportunity to gain insights into the world of cyber risks!

Key Words

THE INNOVATIVE WAY OF COOPERATION BETWEEN A LARGE COMPANY AND START-UPS EXTENDS THEIR SURVIVAL PERIOD - THE EXAMPLE OF ŠTARTAJ SLOVENIJA

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Abstract

Large enterprises seek collaboration with startup companies to gain agility, relevance, and a perception of being socially responsible. For startups, collaboration with large enterprises is extremely important, as on average only 10% of startups survive their first year. This collaboration helps them accelerate development, establish market presence, and improve survival rates. This article presents the brand Štartaj Slovenija, an innovative model of collaboration between a large enterprise and startup suppliers, based on social responsibility. This model supports the thesis that such collaboration ensures startups a faster market entry, longer survival, and greater long-term resilience, while allowing large enterprises to create competitive advantages and build a reputation as socially responsible companies. Štartaj Slovenija transcends traditional partnerships by additionally involving a marketing agency and a mass media outlet in the collaboration. The article also confirms that such innovative collaborations are not risky for large enterprises.

Key Words

Start-up company, a big enterprise, innovative cooperation and partnership, innovative networking, social responsibility.

PROJECT FICA: FRIENDLY INFORMAL IMMERSIVE CLOUD ALTERNATIVE

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Abstract

Friendly informal immersive cloud alternative (FII;)CA) - discover, play, socialize is a project developed by a consortium of five European higher education institutions (HEI) and two European non-governmental organizations (NGO). The project is led by AP University of Applied Sciences and Arts and financed by the European Union (EU) through its Erasmus+ program, The project aims to increase understanding of SVR and to encourage its use as a medium for communication and cooperation between and within organizations. The expected outcomes are the production of a digital ecosystem incorporating ready-to-use immersive spaces for the development of social activities, a virtual gallery exhibiting links to various immersive spaces, but also guidelines for the creation of SVR environments. It will also allow for the development of new courses that will use SVR for innovative learning and teaching practices.

These outputs would be achieved, essentially, through the implementation of three Learning, Teaching and Training Activities (LTTA). The first one to be held at Kokkola, Finland (at Centria University of Applied Sciences), the second one to be held in Malaga, Spain (at Universidad de Malaga), and the third one to be held in Vila Nova de Gaia, Portugal (at ISPGAYA). Each one of these LTTA will challenge the students on different background, contexts where the social virtual spaces are to be developed. Each mobility will involve 40 students, from the participating HEI, that will work in diverse, multidisciplinary and multicultural teams, properly supervised by 10 academic staff members. It is expected that the students will implement one virtual room for each of the participating HEI and eight virtual spaces developed, one per team, in a specific aspect.

Additionally, a methodology for the evaluation of the LTTA is also implemented, with a set of different tools. One of these tools is to assess the added value of the LTTA in the participating students' soft skills. KYSS (Kick Start Your Soft Skills), developed by AP, is the questionnaire to be used to measure the potential increase in the student's soft skills. Additionally, an evaluation of the mobility is also made through a set of focus group conducted with the participating students on the last day of each mobility. Evaluation by the staff is performed in a transnational meeting that occurs shortly after the LTTA takes place.

Key Words

Social virtual reality, active learning, soft skills, digital skills.

A CASE STUDY OF DIGITAL TRANSFORMATION CHALLENGES IN THE FINANCIAL INDUSTRY

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Abstract

The players in the financial industry seek to improve the efficiency of their processes, increase customer satisfaction, and ensure data safety for their customers. Driven by technological innovation and the post-COVID reality, many have undergone the transformation of their processes. Successful transformation requires various efforts, including the modernization of infrastructure. Resistance to change and skill gaps within the workforce further hinder the progress of digital transformation initiatives. The purpose of this research is to explore the key challenges faced by the financial industry in implementing digital transformation. Addressing these challenges requires a strategic approach and effective leadership that plays an essential role in guiding organizations through the complexities of digital transformation. Leaders must navigate challenges such as resistance to change, technological integration, and evolving market demands while implementing change management strategies to foster a culture of innovation and agility.

Key Words

Digital transformation, digital skills, financial industry process owners, change management, information system, innovation management.

GREEN TECH ENTREPRENEURSHIP CHALLENGE HUB

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Abstract

The "Green Tech Entrepreneurship Challenge Hub" project aims to enhance the capacities of vocational education and training (VET) staff and promote entrepreneurship and innovation in green technologies among VET providers and students in Bosnia and Herzegovina (BiH).

A core objective of the project is to establish a challenge-based learning platform, known as the "Challenge Hub." This platform will host innovation challenge competitions, facilitate collaboration between VET providers and industry partners, and deliver educational content focused on entrepreneurship and green technologies. Additionally, the project includes mobility training for VET staff, providing professional development opportunities in Croatia and Slovenia. This training focuses on challenge-based learning methodologies, fostering entrepreneurship, and strengthening industry partnerships.

Two Green Tech Entrepreneurship Challenge competitions will be organized, offering students the opportunity to showcase their innovative and entrepreneurial skills as part of the challenge-based learning framework.

The project also aims to propose policy changes and develop an action plan based on gap analysis to promote work-based learning education in BiH. The outcomes of the project will equip students with essential entrepreneurial and innovation competencies, better preparing them for future employment while contributing to the economic development of Bosnia and Herzegovina.

The project is implemented by a robust consortium of six organizations from Slovenia, Croatia, and Bosnia and Herzegovina. The consortium includes GEA College (Slovenia), Smion and Elektrostrojarska Škola Varaždin (Croatia), and International Burch University, FabLab BiH, and Srednja Ekonomska Škola Sarajevo (Bosnia and Herzegovina). Each organization brings extensive experience and expertise in collaborating with VET providers. By leveraging diverse resources and perspectives, the consortium is uniquely positioned to drive significant progress in promoting entrepreneurship and innovation within the VET sector in Bosnia and Herzegovina. Moreover, this international collaboration facilitates the establishment of crucial connections with companies and organizations across multiple countries, offering valuable opportunities for VET providers and students to gain international experience and expand their professional horizons.

Achievements to Date

The project has successfully delivered the following outputs:

- **Project website and social media accounts:** Development and launch of the project's online presence to facilitate communication and dissemination of project activities.
- **Report on the current state of entrepreneurial skills in VET schools:** A comprehensive analysis detailing the existing level of entrepreneurial competencies within VET institutions in BiH.
- **WP4 curriculum:** A curriculum framework incorporating innovative, active learning methodologies to develop entrepreneurial skills in secondary vocational and technical education in BiH. This curriculum specifically addresses technical and vocational schools, which are commonly part of mixed educational institutions in BiH.
- **Innovation challenge organization manual and MOOC materials for teachers:** A detailed document comprising three integrated components:
 - The curriculum,
 - The Innovation Challenge Manual for Teachers, and
 - The MOOC (Massive Open Online Course) learning materials, forming part of the Innovation Challenge Manual.
- **Mobility Training for VET Teachers:** Successful implementation of training programs at GEA College (Slovenia) and Elektrostrojarska Škola Varaždin (Croatia), enhancing the skills of VET teachers in challenge-based learning and entrepreneurship.
- **Other Deliverables:** Additional outputs and initiatives supporting the project's goals and objectives.

Through these achievements, the "Green Tech Entrepreneurship Challenge Hub" project continues to foster innovation, enhance entrepreneurial education, and build stronger ties between the educational sector and industry in Bosnia and Herzegovina.

Key Words

Entrepreneurship, innovation, green technology. vocational education and training, Bosnia and Herzegovina.

INVESTMENT STRATEGIES OF SOME OF THE MOST SUCCESSFUL INVESTORS IN THE WORLD'S STOCK MARKETS AND A COMPARISON OF THEIR PROFITABILITY WITH SLOVENIAN FUNDS

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Abstract

In this paper, the authors analyze investment philosophies and strategies of three financial mogul companies in order to find out what strategies they apply, yielding high returns. They also analyze their performance in comparison to Slovenian mutual funds and the broader stock market. The authors focus on some key research hypotheses. First, they are interested in assessment and monitoring of the company's future intrinsic value, which refers to a fundamental, objective value contained in a financial asset. If the market price is below this value this financial asset may be a good buy or if it is above it may be a good sale. While studying the investment strategies, they check if such an assessment enables above-average investment returns. Second, the authors state that the fund's profitability and risk are a reflection of the chosen investment strategy. Investors generally expect higher returns from riskier investments. Risk tolerance is one of the critical factors determining the return on investment. Generally, higher-risk investments have the potential for higher returns, but they also come with a greater risk of loss. The authors compare and test how the risk is embedded in the investment strategies of three renowned financial investors and Slovenia mutual funds. Third, the authors set a hypothesis that time and patience are among the most critical factors in investing. The authors's fourth research hypothesis relates to the question if the stock market always accurately reflect the value of individual companies. Many researchers today argue that some market participants behave irrationally, what leads to market inefficiency. They suggest that the financial market can never be perfectly efficient. In theoretical part of the paper, the authors begin with a brief literature overview underlying how different factors affect investment returns, especially focusing on the indicator ROI. Further, they shortly represent investment strategies of Buffett, Ackman, and Palihapitiya. In the empirical part of the paper, they perform some financial calculations – annual return, average annual return, annual standard deviation, Sharpe ratio, and they then proceed with a Monte Carlo simulation and a CAPM model. The authors findings show that a deep understanding and accurate assessment of a company's intrinsic value leads to above-average returns. The risk and return of a fund are tied to the strategy chosen, with those willing to accept a higher risk often achieving higher returns. They underline the importance of time

and patience in investing and observe that the stock market does not always reflect the exact value of an individual company accurately, which emphasizes the importance of critical judgement and not blindly following market trends.

Key Words

Influential Investors, Market Efficiency, Stock Market, Intrinsic Value, Company Valuation

“HOW DOES SOCIAL ENGINEERING EXPLOIT EMPLOYEE WEAKNESSES?”

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Abstract

In the world of information security, the employee is an important factor. This ranges from the so-called victim bias (the belief “it cannot happen to me”) to the key role of emotions in information fraud. The importance of neurodiversity is also important here: how employee’ cognitive abilities influence reactions to various incidents in information security. Knowledge of information behaviour belongs to an interdisciplinary field that includes psychology, sociology, computer science and neuroscience. Attackers are increasingly attacking employee, not technical devices because this is more efficient and cheaper. Employee (with all their needs, motives, attitudes and internal personality factors) are critical to the information system. It interacts with the system, detects and monitors threats, makes errors and corrects errors. A malicious error is an employee decision and cannot be eliminated from the information system, but preventive measures and procedures can reduce its harmful effect. With what opinions, attitudes, beliefs and values does the employee identify? In the work environment, an employee forms behavioural intentions towards protecting the organization’s data and information under the influence of attitudes towards information security, subjective norms and perceived behavioural control.

Key Words

Information security, psychology, employee.

THE DEXI MODEL FOR CONSISTENCY ASSESSMENT OF DIGITAL FORENSIC INVESTIGATION

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Abstract

The article presents the fundamental principles of digital forensics and the necessary conditions for evidence to be valid in court proceedings, and a developed software model for assessing the consistency of the material and procedural part of a forensic investigation.

Computer forensics can be defined as the process of identifying, securing, analyzing, and presenting evidence in electronic form in a manner that is legally acceptable. It follows from the above definition that there are certain rules and boundaries that must be followed when conducting a digital investigation.

The method for multicriteria decision making was used to develop a qualitative model for assessment of digital forensic investigation with DEXi software. The developed model is intended to support the assessment of the compliance of a digital forensic investigation with professional and legal requirements.

Key Words

Digital forensic, forensic principles, digital evidence, rules of evidence, decision making; DEXi.

ENHANCING PROJECT MANAGEMENT EDUCATION THROUGH THE IMPLEMENTATION OF THE PROJECT APPROACH AND SIMULATIONS

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Abstract

This study examines the integration of the Project Approach combined with simulations in undergraduate Project Management (PM) education, aiming to foster active learning, student engagement, and collaborative skills development. The objective was to enhance students' understanding of project management principles and practical skills development.

A case study incorporating elements of action research was conducted with 30 full-time students at Gea College during the 2024/25 academic year. Pre- and post-course surveys were employed to assess students' knowledge acquisition and perceptions of the effectiveness of this pedagogical approach.

Findings indicate that students successfully applied PM principles within simulated real-world projects, reinforcing their problem-solving, collaboration, communication, presenting and critical thinking skills. The effectiveness of the Project Approach is attributed to its foundation in multiple learning theories, including action learning, reflective practice, and continuous peer and teacher feedback. Furthermore, students emphasized the importance of soft skills in project execution, particularly leadership, communication, and teamwork.

While initial results support the efficacy of this approach, further research is required to quantify its long-term impact. The findings contribute to innovative teaching practices in business education, emphasizing applied learning approaches.

Key Words

Project management, project approach, simulations, active learning, collaboration.

EXPLORING BUSINESS LONGEVITY IN ITALIAN SMES: EARLY FINDINGS

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Abstract

This study examines the key factors influencing the longevity of Italian SMEs, a critical yet underexplored issue in strategic management. Given that SMEs account for a significant portion of the economy but face high failure rates, understanding the determinants of their survival is essential.

A quantitative approach was adopted, analyzing data from 111 Italian SMEs across various industries. The study utilized a structured questionnaire to assess constructs related to finance, innovation, governance, performance, and competencies. To evaluate the proposed relationships, Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied using SMART-PLS 4.1, a robust technique suited for small sample sizes and complex models.

The results do not confirm any direct relationships at $p < 0.05$, suggesting that SME longevity is shaped by multifaceted and interdependent factors. However, finance shows potential relevance at $p < 0.1$, while innovation and performance indicate influence at $p < 0.2$. These findings highlight the limitations of traditional static models like RBV and underscore the relevance of Dynamic Capabilities Theory (DCT) in explaining SME survival. Future research should refine methodological approaches, expand the sample, and incorporate longitudinal analysis to track long-term trends.

Key Words

Longevity, SMEs, dynamic capabilities theory.

INVESTMENT STRATEGIES OF SOME OF THE MOST SUCCESSFUL INVESTORS IN THE WORLD'S STOCK MARKETS AND A COMPARISON OF THEIR PROFITABILITY WITH SLOVENIAN FUNDS

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Abstract

In this paper, the authors analyze investment philosophies and strategies of three financial mogul companies in order to find out what strategies they apply, yielding high returns. They also analyze their performance in comparison to Slovenian mutual funds and the broader stock market. The authors focus on some key research hypotheses. First, they are interested in assessment and monitoring of the company's future intrinsic value, which refers to a fundamental, objective value contained in a financial asset. If the market price is below this value this financial asset may be a good buy or if it is above it may be a good sale. While studying the investment strategies, they check if such an assessment enables above-average investment returns. Second, the authors state that the fund's profitability and risk are a reflection of the chosen investment strategy. Investors generally expect higher returns from riskier investments. Risk tolerance is one of the critical factors determining the return on investment. Generally, higher-risk investments have the potential for higher returns, but they also come with a greater risk of loss. The authors compare and test how the risk is embedded in the investment strategies of three renowned financial investors and Slovenia mutual funds. Third, the authors set a hypothesis that time and patience are among the most critical factors in investing. The authors's fourth research hypothesis relates to the question if the stock market always accurately reflect the value of individual companies. Many researchers today argue that some market participants behave irrationally, what leads to market inefficiency. They suggest that the financial market can never be perfectly efficient. In theoretical part of the paper, the authors begin with a brief literature overview underlying how different factors affect investment returns, especially focusing on the indicator ROI. Further, they shortly represent investment strategies of Buffett, Ackman, and Palihapitiya. In the empirical part of the paper, they perform some financial calculations – annual return, average annual return, annual standard deviation, Sharpe ratio, and they then proceed with a Monte Carlo simulation and a CAPM model. The authors findings show that a deep understanding and accurate assessment of a company's intrinsic value leads to above-average returns. The risk and return of a fund are tied to the strategy chosen, with those willing to accept a

higher risk often achieving higher returns. They underline the importance of time and patience in investing and observe that the stock market does not always reflect the exact value of an individual company accurately, which emphasizes the importance of critical judgement and not blindly following market trends.

Key Words

Influential Investors, Market Efficiency, Stock Market, Intrinsic Value, Company Valuation

INTRODUCTION

The process of making investment decisions entails a cognitive assessment that involves choosing one alternative from a range of options based on available information. Given the highly competitive global business environment, investors are compelled to thoroughly study and develop their intuition to make informed investment choice.

The efficient market hypothesis states that stocks are always traded on stock exchanges at their fair value, which means that investors cannot buy undervalued stocks or sell them at inflated prices. Although the hypothesis establishes the foundation of modern financial theory, it is highly controversial. Proponents of the hypothesis argue that it is pointless to look for undervalued stocks or try to predict market trends through fundamental or technical analysis. The hypothesis states that without insider information, no one can generate risk-adjusted excess returns consistently enough. Thus, it seems that the only real approach to achieving higher returns is to invest in riskier investments (Downey, 2023). Despite this, financial moguls like Warren Buffett, Bill Ackman and Chamath Palihapitiya consistently manage to achieve returns that exceed the market average. We wonder what the secret of their success is.

The aim of the paper is to study and present the investment philosophies and methods of three globally recognized investors – Warren Buffett, Bill Ackman and Chamath Palihapitiya. We examine their philosophies and approaches to investing to better understand what is behind their success. Theoretical concepts are supported by empirical data and case studies. As part of the research, we conducted three case studies that were not included in the article due to their limited scope (Buffett, 2013; Canadian Pacific, 2012; Dinner, 2023; Greenslade, 2014; Sheetz, 2021; USSEC, 2019; Virgin Galactic, 2019, 2022a, 2022b, 2023). The following investments were discussed: Buffett's investment in The Washington Post, Ackman's investment in The Canadian Pacific Railway, and Palihapitiya's investment in Virgin Galactic. These case studies were key to understanding the decision-making processes behind each investment made. A more detailed discussion of the studies is available in the author's thesis (Peternel, 2023). In the research, we conducted a comparative analysis, comparing the financial indicators of Berkshire Hathaway and Pershing Square with the returns of the S&P 500 index and the selected Slovenian mutual funds. On the basis of a financial analysis, we prepared the calculations necessary for the comparative analysis. We obtained the data from the Yahoo Finance databases and the Slovenian mutual funds databases. An important part of this paper

is the Monte Carlo simulation, which enables the modelling of potential returns from continuous annual investments in Pershing Square, Berkshire Hathaway, the S&P 500 index and the selected Slovenian mutual funds. Using the CAPM model, we estimated the expected returns of Pershing Square, Berkshire Hathaway, the selected Slovenian mutual funds and the S&P 500 index in terms of their systematic risk, expected market return and risk-free rate of return.

With this paper, we want to determine whether and to what extent the principles and philosophies of the selected investors influence their investment decisions, whether the selected mutual funds exceed the return of the S&P 500 index and, if so, we aim to analyze the factors that contributed to their higher return, how the investment strategies are reflected in the profitability and risk of the fund, what is the profitability of the selected American funds compared to the selected Slovenian funds and, last but not least, what influence do knowledge and tracking of the intrinsic value of the company have on the final investment profitability.

1. Theoretical Background

The terms “investments” and “investing,” which can be found in almost all economic sectors, and of course also in the field of social activities, are closely related to the preservation, reduction or expansion of consumption. Investment plays a major role in the expansion of both personal and social consumption and in the increase or decrease in the economic growth of any national economy (Bukvič, 2023).

Investment refers to the act of allocating capital with the expectation of generating a rate of return in the future. Besides looking for increasing the wealth of the shareholders, what mainly falls within the frame of the value based management theory (Bukvič, 2016), investors have to consider some other aspects which are becoming also very relevant and deal with social responsibility. This implies a so called impact investing which is defined as the deployment of funds into investments that generate a measurable and beneficial social or environmental impact alongside a financial return on investment. An innovative way of boosting the private sector's contribution to sustainable development can be achieved with impact investing.

The purpose of investing is to direct current financial resources into various forms of real or financial assets to achieve expected returns in the future. Here we collide with the concept of uncertainty. The longer the period to which the investment relates, the greater the uncertainty regarding the generation of future returns. It accordingly follows that time and uncertainty are extremely important investment dimensions. We make an investment decision today, and reap its results (the expected returns) in the future. If the investment decision was not considered enough, the future consequences can be very painful for the investor, even fatal (failed investments as a result of wrong investment decisions). Therefore, when making investment decisions, information that can help form a vision about the levels of certainty of the investment's status in the future is very important.

Serious investors, i.e. companies in the real sector of the economy, various organizations in the field of social activities, individuals, “venture” capitalists (blue angels), and financial institutions such as banks, funds, etc., undertake investments in a prudent manner. This means, among other things, that they try to check and evaluate the economic benefits of their planned investments before making

investment decisions. For this purpose, they use a wide variety of investment criteria, giving preference to those that also take into account the temporal aspect. The most widespread among dynamic investment criteria is net present value. The other one is return on investment, ROI. It can be confused with the profits of an investment. The key distinction between profits and ROI is that ROI is concerned with the money investors invest and the investment returns they receive based on the business's net profit. Profit is a metric used to assess a company's performance (Quanloop team, 2024).

Most investors will be looking for investments with the highest ROI, even though they should consider other factors, like dispersion of ROI and adjusting it with time. The ROI is a tool used to calculate the rates of return on money invested to determine whether or not to invest. Measuring ROI allows investors to assess the performance of different assets in an investment portfolio. A high ROI means that their returns are higher than the cost of the investment. A lower ROI would mean the opposite. There are several factors which influence ROI, which cause its fluctuations. As the simplest form of returns measurement in percentage, ROI aids in the selection of various investment possibilities. As an investment grows, so does the importance of its ROI. The investors track their ROI and compare the return patterns. Positive or negative ROI will help investors determine whether to hold onto that investment or adjust it to the market.

In this context, we study investment strategies of three globally recognized investors, i.e. Warren Buffett, Bil Ackman and Chamatha Palihapitiya, and compare their investment returns to Index S&P 500 and some Slovenian mutual funds.

1.1 Warren Buffett's Investment Strategy

In order to effectively manage Berkshire Hathaway and its investments, Buffett wrote twelve principles in a 2013 letter to the company's shareholders, which are classified into four main groups: 1. Business principles, 2. Management principles, 3. Financial principles and 4. Market principles. In summary, the short-term performance of an investment does not mean that the portfolio managers are good or bad. The period in which we measure the ability to generate returns is simply too short to draw any meaningful conclusions. However, if we look at the company's operating results, we can assess progress when the share price deviates from expected returns. Buffett emphasizes that the key to a successful investment is a competitive advantage and a favourable price compared to the internal value (margin of safety) (Buffett, 2014; Hagstrom, 2014; Klarman, 1999; Buffett, 1985).

1.2 Bill Ackman's Investment Strategy

Bill Ackman is a hedge fund manager and investor known for his use of activist investing (Dallas, Bainbridge and Bohinc, 2001). Ackman's activist investment approach is based on acquiring large stakes in undervalued companies through his hedge fund Pershing Square Capital Management. It works with the management of these companies to drive change that can increase shareholder value. Changes can be reflected in operational improvements, reallocation of capital, or in the restructuring of the management team. Ackman often expresses his opinion publicly. He prepares presentations or writes open letters to the company's stakeholders in which he explains his investment strategy (Tenorio, 2021).

1.3 Chamatha Palihapitiya's Investment Strategy

Chamath Palihapitiya focuses on investing in high-tech companies with high growth and transformation potential. He looks for opportunities in undervalued companies with long-term competitive advantages. His strategy focuses on making unconventional decisions that deviate from market trends, thorough data analysis, and trust in management with a proven ability to lead and make decisions effectively. He believes in the power of technology to solve social problems and promotes companies that have a positive impact on society. He supports ethical behaviour, transparency and socially responsible investing. Issues of diversity, equality and inclusion are also of critical significance. As the co-founder of Facebook, he promotes a form of capitalism where success is measured not only by profit, but also by social impact (Dure, 2023).

1.4. Differences in Strategies

The main differences between the selected investors' strategies lie in risk tolerance, time horizon, and level of involvement with the companies they invest in. Buffett is highly conservative, focusing on long-term investments with minimal risk. He is a passive investor, and takes a "buy and hold" approach. Ackman on the other hand, is more moderate in terms of risk but extremely tactical. He often accelerates turnarounds through active engagement and driving corporate changes. Out of the three Palihapitiya takes on the riskiest investments, primarily focusing on tech-centric start-ups with high growth potential. Like Ackman, he is involved in the companies he invests in, focusing on shaping them for long-term growth.

1.5. Literature Review: How Different Factors Affect Investment Returns

In traditional finance, investors are assumed to behave rationally while making financial decisions. In contrast, proponents of behaviour finance argue that investors are not always rational. In fact, the financial decisions they make and their investment performance are influenced by various behavioural factors. So, the literature is filled with a plethora of studies on finding the impact of behavioural factors on decision-making and investment performance. A group of researchers (Uzma et al., 2024) tried to determine whether psychological factors, market factors, social factors, and financial literacy impact investment performance while testing the mediating role of decision-making. Interestingly, the results of their study are persistent with the prospect theory and assert that investors do not always make rational judgments when making financial investments.

Mutswenje (2009) confirmed that there seems to be a certain degree of correlation between the factors that behavioral finance theory and previous empirical evidence identify as the for the average equity investor. He found out that the most important factors that influence individual investment decisions were: reputation of the firm, firm's status in industry, expected corporate earnings, profit and condition of statement, past performance firms stock, price per share, feeling on the economy and expected dividend by investors.

Media can also be an influential factor affecting investment returns. The rapidly increasing scientific research on the stock market and the visible impact of media on equity prices are nowadays in limelight. To a greater extent, causal analysis can

reckon the sentimental effect of the broadcasted content on stock valuation. Renju and Biju (2023) carried out a study, which perfectly identify the deluge of information during quick leaps, and it is regarded as a beneficial formulation for investors when evaluating stocks with a fewer number of news mentions. Their study also infers an explicit information flow and direction of causality between news sentiment and stock price movement, which can be used to devise future investment and consumption strategies.

The findings of the analysis carried out by Mulyadi, Zulkifli and Widyastuti (2023) reveal that financial literacy have negative effect on investment decisions. Conversely, financial behaviour, risk reception, and overconfidence have positive effect on investment decisions. Additionally, risk perception have positive effect on organizational performance. However, financial literacy, financial behaviour, overconfidence, and investment decisions have no effect on organizational performance. Consequently, it can be inferred that all factors influencing investment decisions have the capacity to influence organizational performance.

Relating to impact investing, Jeffers, Lyu and Posenau (2024) provided an analysis of the risk exposure and consequent risk-adjusted performance of impact investing funds, private market funds with dual financial and social goals. Adding a public sustainability factor to their pricing model helps explain impact fund returns, though the correlation of impact fund cash flows with the public sustainability factor on its own is not necessarily positive.

Return on Investment (ROI) is the most crucial aspect of choosing between a good investment strategy and a bad one. Earning great ROI returns is the ultimate goal of stock market investment. There are several factors determining the return on investment of an asset class or a fund. Bhatia (2023) introduced top ten factors that contribute to the success of an investment strategy: investment type, time horizon, risk tolerance, market conditions, diversification, investment costs, economic conditions, taxation, monitoring and rebalancing and performance evaluation. Let us expose only the last one. According to Bhatia, keeping track of how the investments are performing is vital for making informed decisions. Investors should assess their investments based on their historical performance, market conditions, and their financial goals. If an investment consistently underperforms or no longer aligns with the objectives, it may be time to consider selling or reallocating those assets. Effective performance evaluation allows investors to make adjustments that can positively impact the factors determining the return on investment.

For the purpose of our research, where we are trying to assess the investment returns through the prism of investment strategies of the most successful investors, we are focusing on the following factors.

Market Conditions, Intrinsic Value and Market Efficiency

Market conditions are dynamic and have a direct impact on the factors determining the return on investment. Economic factors, geopolitical events, and market sentiment all influence the performance of investments (Bhatia, 2023). For example, during a bull market, most investments tend to perform well, leading to higher ROIs. On the other hand, during a bear market or economic recession, investments may struggle, resulting in lower returns. Being aware of current market conditions and adjusting the investment strategy accordingly is essential for optimizing ROI.

Intrinsic value refers to a fundamental, objective value contained in an object, asset, or financial contract. It may be a good buy if the market price is below this value or a good sale if it's above it. There are several methods for arriving at a fair assessment of a share's intrinsic value. Intrinsic value is fundamental for value investing, a strategy established by Benjamin Graham and popularized by Warren Buffett. Scholars emphasize that the stock market does not always reflect a company's true value (Hagstrom, 1999; Greenblatt, 2010). The efficient market hypothesis (EMH) states that securities markets are highly efficient in reflecting all available information about individual stocks as well as about the stock market as a whole (Fama, 1970). However, the accuracy of EMH is difficult to test. Many authors today argue that, while some market participants behave irrationally - leading to market inefficiencies - such pricing irregularities are present in the short-term. They suggest that the market can never be perfectly efficient as there would be no incentive to uncover new information which is then reflected in market prices (Malkiel, 2003).

The recent underperformance of value investing strategies in equity markets has sparked debate about their continued relevance. Several criticisms of value investing have been raised, such as increased share repurchasing, monetary policy changes, oversimplified value measures and the rise of intangible assets, which makes it harder to assess a company's value using traditional accounting. A recent study evaluated these criticisms, but found little empirical evidence to support them (Israel, Laursen and Richardson, 2020). Existing literature, however, lacks studies on how modern strategies, such as Bill Ackman's activist-investing or Chamath Palihapitiya's tech-driven strategy, evaluate intrinsic value in fast-moving industries.

Returns and Risk of Investments: The Eternal Dilemma of Investors

Risk and return are inherently linked, as supported by the modern portfolio theory (Markowitz, 1952) and the Capital Asset Pricing Model (CAPM) (Lintner, 1965; Sharpe, 1964). Investors generally expect higher returns from riskier investments. According to Bhatia (2023), risk tolerance is one of the critical factors determining the return on investment. It defines investors' ability and willingness to endure the ups and downs of the investment market. Generally, higher-risk investments have the potential for higher returns, but they also come with a greater risk of loss. Investors with a high-risk tolerance may opt for aggressive growth strategies, such as investing in emerging markets or startups. Conversely, investors with a low-risk tolerance may prefer more conservative options like bonds or real estate. It's important to align their risk tolerance with their investment choices, as it plays a significant role in determining the return on investment.

The risk is not the same for all investors. Different investors take different risks. We are talking about risk appetite. Risk appetite is the degree of broad-based risk that an investor is willing to accept in pursuit of their strategic goals. Risk appetite reflects the risk management philosophy an investor wants to adopt and consequently influences their risk culture, way of operating and decision-making (The Global Fund, 2018). When it comes to a low-risk investment, the return is generally low as well. Similarly, high risk brings with it the possibility of high losses. Therefore, investors should diversify their portfolio. Diversification of investments has a statistical effect in terms of reducing overall risk. Investors, especially beginners, are often advised to diversify their portfolio (Bukvič, 2024). Both Ackman's as well as Palihapitiya's investment strategies align with this approach, as

they take on moderate to high-risk investments with the expectation of high returns. While much of the literature covers traditional risk-return frameworks, less attention is given to fundamentals of a business. Models such as CAPM and the beta coefficient focus too heavily on market prices, failing to take into account specific business fundamentals or broader economic developments. One could argue that risk is less about market price volatility and more about an investor's understanding of the underlying business and its long-term potential.

Macroeconomic Factors

Stock markets are greatly affected by macroeconomic conditions. Economic indicators, such as inflation rates, interest rates, and GDP growth, play a vital role in determining the return on investment. These indicators can affect the value of the investments, the cost of borrowing, etc. For example, high inflation rates can erode the purchasing power of investors's money, making it essential to invest in assets that outpace inflation. On the other hand, low interest rates can make borrowing cheaper, potentially boosting the return on investment for leveraged strategies. As Bhatia (2023) says, staying informed about economic indicators is essential for making informed investment decisions. Many studies have investigated the link between macroeconomic variables and stock market volatility (Binswanger, 2000; Fama, 1990, Ozlen and Ergun, 2012). Certain unfavourable macroeconomic conditions, such as slow growth combined with rising inflation, high volatility or illiquidity, make it difficult for assets to generate long-term returns. Different asset classes respond differently to these factors. For example, stocks tend to do well during periods of growth, while bonds may perform better during economic downturns (Ilmanen, Maloney, and Ross, 2014). Extreme situations, such as the COVID-19 pandemic, can have serious negative impacts on stock market returns. A 2022 study on the global stock markets during COVID-19 found a decrease in mean returns and an increase in volatility (Chowdhury, Khan and Dhar, 2022). Existing literature lacks focus on how specific strategies, like Ackman's activist investing, perform under different macroeconomic conditions.

Interest Rates

Monetary policy, specifically through interest rate changes, influences the returns on financial assets and therefore affects their prices. This, in turn, impacts economic decisions and growth. Bernanke and Reinhart (2004) argue that low interest rates, whether current or expected, encourage investments, as borrowing money becomes cheaper. Some research, however, suggests that this relationship is small and mostly dependent on inflation rates (Sellin, 2001). A more recent Johansen cointegration analysis showed a long-term equilibrium relationship between stock prices, inflation rates, and real interest rates. The study found that changes in real interest rates and inflation rates Granger cause significant changes in stock prices. It concluded that real interest rates are positively associated with stock prices, as higher interest rates often indicate stronger economic conditions. Inflation rates, however, are negatively associated with stock prices. The analysis also showed a significant speed of adjustment between stock prices and real interest rates, meaning that when there is a deviation from the long-term equilibrium, the stock prices will adjust relatively quickly (Eldomiaty, Saeed, Hammam and AboulSoud, 2020).

Regulation

Hahn and Hird (1991) were the first to provide a comprehensive analysis of the costs and benefits of federal economic and social regulation. Since then the macroeconomic effects of regulation have been widely studied (Goff, 1996; Dawson and Seater; 2013). Regulations help maintain market safety and stability, and protects consumers, but often at the cost of lower profits for businesses. Regulation imposes a significant cost on firms (Ince and Ozsoylev, 2024). Businesses also face regulatory risk, which refers to the potential changes in laws, regulations, or government policies that could adversely affect a company's operations or profitability. This is particularly relevant for investors like Palihapitiya, who focuses on high-growth and emerging sectors like technology and space travel, where regulatory shifts can significantly impact a company's long-term prospects.

Taxation

Taxes can have a significant impact on investors' ROI. The way investments are taxed can vary depending on factors like investors' location and the type of investment. Understanding the tax implications of the investments is crucial to maximizing the after-tax return on investment.

For example, long-term capital gains are often taxed at a lower rate than short-term gains. Additionally, certain investments, like municipal bonds, may offer tax-free interest income. Bhatia (2023) asserts, that by strategically managing investors' tax liabilities, they can improve the factors determining the return on investment. Understanding how the investments are taxed is critical to ROI fluctuations. The government taxes all incomes, and investment income is no exception. Taxes also depend on the country since both income tax and capital gains tax may be lower in those countries, and in some countries, there may be no capital gains taxes at all. Some countries will give tax breaks on investments to boost investors' portfolio. Once the investors know the real rate of taxes and any tax benefits, they can decide where to allocate their investments more to maximise their ROIs

2. Research Methodology

With our research, we set the following research hypotheses:

H1: Proper assessment and monitoring of the company's future intrinsic value enables above-average investment returns.

H2: The fund's profitability and risk are a reflection of the chosen investment strategy. Investment funds that are willing to take on more risk often aim for higher returns, while more conservative funds aim for lower, but more stable returns.

H3: The most important factors in investing are time and patience.

H4: The stock market does not always accurately reflect the value of an individual company, so it is important to critically evaluate every decision and not blindly follow market trends.

In the theoretical part of the research, we used the scientific method of description as well as the scientific methods of classification, comparison, analysis and synthesis. In the empirical part of the research, we used statistical methods (arithmetic mean, standard deviation) and analyzed the data using the Sharpe ratio, performed a Monte Carlo simulation and used the CAPM model.

For the research, we used secondary data from the Yahoo Finance database and the Slovenian mutual investment funds databases. The research covers the 2018-2022 period.

3. Results and Discussion

3.1 The return on Shares of Two Companies Listed on Global Stock Exchanges

Let's see how a hypothetical \$10,000 investment in Berkshire Hathaway (BRK-A) stock would have grown over the past five years (2018-2022). The calculated values are shown in Table 1.

Table 1: Stock prices, returns and value of a hypothetical \$10,000 investment in Berkshire Hathaway stock over the period 2018-2022.

Year	Stock price in January (in \$)	Stock price in December (in \$)	Annual return (in %)	Final value of the investment (in \$)
2018	295,755	306,000	3.46	10,346.00
2019	304,057	339,590	11.68	11,554.41
2020	342,261	347,815	1.62	11,741.59
2021	343,525	450,662	31.18	15,402.62
2022	454,300	468,711	3.17	15,890.89

Based on the calculations, we find that the investment of \$10,000 in Berkshire Hathaway stock would grow to about \$15,890 in the period between 2018 and 2022. The investment would grow by 59% in five years.

Figure 1 shows Berkshire Hathaway's annualized return and the movement of a hypothetical \$10,000 investment in Berkshire Hathaway stock over the 2018-2022 period.

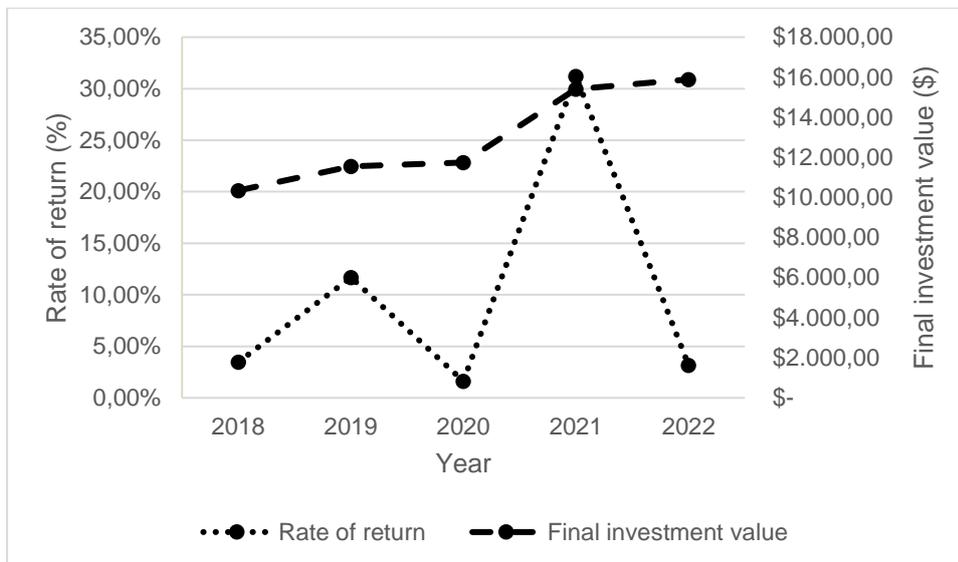


Figure 1: Graphic representation of Berkshire Hathaway's annualized return and the performance of a hypothetical \$10,000 investment in Berkshire Hathaway's stock over the 2018-2022 period.

Source: Yahoo Finance (2023a).

Let's see how a hypothetical \$10,000 investment in Pershing Square Holdings Ltd. (PSH.AS) stock would have developed in the last five years (2018-2022). The calculated values are shown in Table 2.

Table 2: Stock prices, returns and value of a hypothetical \$10,000 investment in Pershing Square stock over the 2018-2022 period.

Year	Stock price in January (in \$)	Stock price in December (in \$)	Annual return (in %)	Final value of the investment (in \$)
2018	12.84	12.04	-6.23	9,377.00
2019	12.04	18.24	51.50	14,206.00
2020	18.57	33.89	82.50	25,926.00
2021	34.28	40.23	17.36	30,427.00
2022	39.44	34.35	-12.91	26,500.00

A \$10,000 investment in Pershing Square stock would increase to about \$26,500 from 2018 to 2022, a 165% increase. Despite two years of negative returns, the analysis showed a long-term growth trend. Short-term losses do not reflect long-term trends, as high returns in other years more than offset these losses. Although the path has

been unpredictable, the company's long-term strategy is successful in uncertain market conditions.

Figure 2 shows Pershing Square's annualized stock return and the performance of a hypothetical \$10,000 investment in Pershing Square stock over the 2018-2022 period..

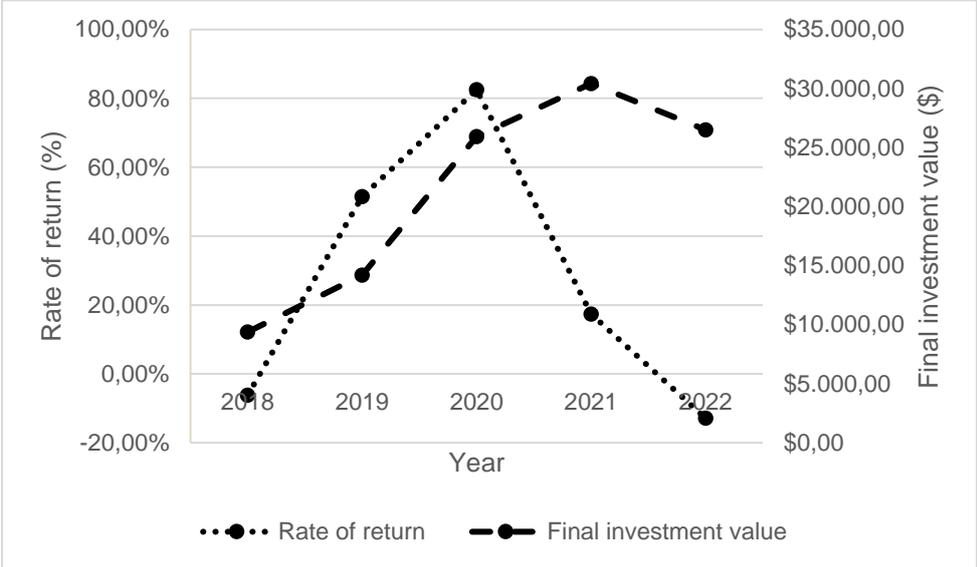


Figure 2: Graphical representation of Pershing Square's annualized stock return and the performance of a hypothetical \$10,000 investment in Pershing Square stock over the 2018-2022 period.

Source: Yahoo Finance (2023b).

An analysis of Berkshire Hathaway and Pershing Square's stock returns in the 2018-2022 period highlights the importance of a long-term strategy and patience, which are key for investors. Despite short-term fluctuations and negative returns in some years, high positive returns in other years led to overall investment growth. Pershing Square's stock stood out for its outstanding returns, which more than offset short-term losses. These fluctuations show that the stock market does not always reflect the true value of companies, which requires critical judgment from investors.

b. Average return on shares of selected companies, mutual funds and the S&P 500 index

The average return is an indicator that is calculated as the geometric mean of the annual returns in the studied period; it takes into account the effect of compound interest (Thakur, 2023).

We calculate annual returns for the following stocks of companies and mutual funds: Pershing Square, Berkshire Hathaway, NLB Razvita Evropa Delniški (NLB Equity Advanced Europe), NLB Globalni Delniški (NLB Equity Global), TRIGLAV Severna Amerika (TRIGLAV North America), TRIGLAV Evropa (TRIGLAV Europe) and the S&P 500 index.

Among the selected companies and mutual funds, the shares of Pershing Square (PSH.AS) achieved by far the highest average annual return during the five-year period under review - 21.74%. Compared to the S&P 500 index, this return is truly

impressive. A higher return often comes with a higher risk, which we will explore in greater detail below.

Berkshire Hathaway (BRK-A) returns were 9.65% on average over the past five years, outperforming the S&P 500. However, BRK-A lagged Pershing Square by a significant margin. The underperformance of shares (BRK-A) can be attributed to Berkshire Hathaway's long-term and conservative strategy, which focuses on stable companies with strong business models. Such an approach is reflected in market-beating stock prices with relatively little risk for investors. This strategy may mean lower short-term returns, but aims for long-term stability and growth.

The NLB Razvita Evropa Delniški mutual fund, which focuses on investments in established European companies and is managed by NLB Skladi (NLB Funds), recorded an average annual return of its unit of property of only 2.40% in the period under review. This return is much lower both in comparison to the shares of Pershing Square and Berkshire Hathaway and even to the average return of the S&P 500 index. This allows us to draw conclusions that the investment strategy of the mutual fund is less successful. However, a lower return does not necessarily mean that a mutual fund or this specific investment is a poor choice for investors. Its long-term profitability is highly dependent on the performance of the European economy. In the following subsection, we will take a closer look at its stability and the size of the risk it assumes.

The NLB Globalni Delniški mutual fund, managed by NLB Skladi, achieved an average annual return per unit of 5.07% in the five years under review. The annual return is much better than the return of the NLB Razvita Evropa Delniški mutual fund, but it still does not reach the return of the S&P 500 index. According to the information on their website, the mutual fund is intended for investors who want to invest in a well-diversified global stock portfolio, as it is highly diversified. Although the return of the NLB Globalni Delniški mutual fund is lower than the return of the S&P 500 index, its geographical and sector diversification can be attractive to investors (NLB Skladi, 2023a).

TRIGLAV Severna Amerika, a mutual fund managed by Triglav Skladi (Triglav Funds), achieved an average annual return of 8.96%, which exceeds the return of the S&P 500 index, but still lags behind the return on shares of Berkshire Hathaway and Pershing Square. The Triglav Skladi website describes the mutual fund as high-risk, so it is important to look at how effectively it creates value relative to the accepted risk (Triglav Skladi, 2023b).

The TRIGLAV Evropa mutual fund, managed by Triglav Skladi, achieved the lowest average annual return per unit of all the mutual funds and company shares discussed, namely only 1.36%. TRIGLAV Evropa is a mutual fund that focuses on investments in European companies. However, it seems that the regional focus did not bring the desired results in the period under review. Possible reasons for such a low return could include a weaker economic performance in Europe or a failed investment strategy of the mutual fund. In addition, this mutual fund is considered high-risk, so the low returns are surprising (Triglav Skladi, 2023a).

The S&P 500 index achieved an average annual return of 7.33% during the period under review. Investing in funds that track the S&P 500 index is often considered less risky than investing in individual stocks because the index consists of 500 different

companies, allowing for greater diversification. However, it is important to emphasize that diversification in itself does not eliminate all investment risks. The S&P 500 index is one of the most commonly used criteria for assessing investment returns and is accepted as a good indicator of the overall performance of the market, so in this part, it will serve as a basis for comparing the performance of the discussed mutual funds and companies.

Table 3 shows the average returns on shares of selected companies, unit values of mutual funds and the S&P500 index over the last five-year period.

Table 3: Overview of the average annual return of selected mutual funds, company shares and the S&P 500 index in the 2018-2022 period.

Stock, fund, index	Average annual return (in %)
PSH.AS (Pershing Square)	21.74
BRK-A (Berkshire Hathaway)	9.65
NLB Razvita Evropa Delniški	2.40
NLB Globalni Delniški	5.07
TRIGLAV Severna Amerika	8.96
TRIGLAV Evropa	1.36
S&P 500	7.33

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c, 2023f, 2023g).

Figure 3 shows a comparison of the average annual return of selected mutual funds, company shares and the S&P 500 index for the last five-year period.

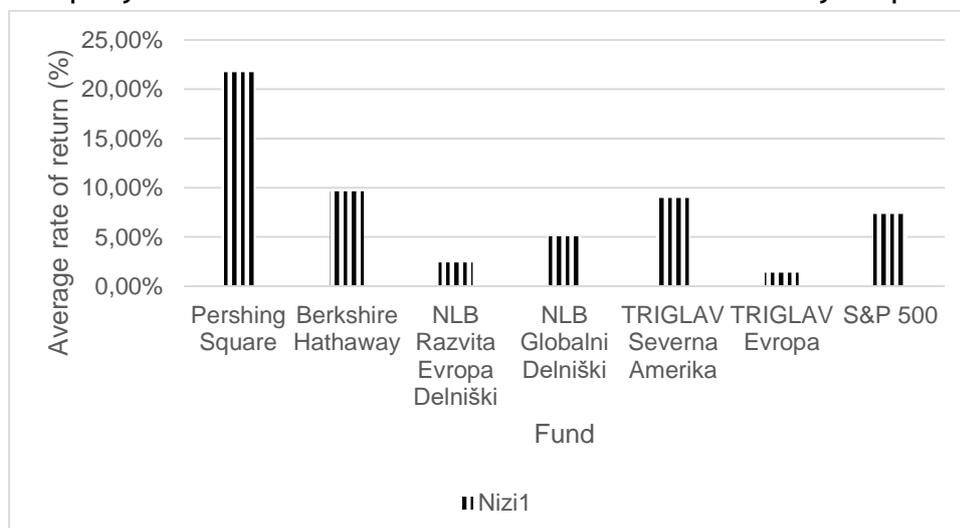


Figure 3: Graphic representation of the average annual return on shares of selected companies, mutual funds and the S&P 500 index in the 2018-2022 period.

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c).

The quantitative analysis of the average return on selected mutual funds and shares of the selected companies in the 2018-2022 period reveals complex dynamics that affect the return. Various factors such as investment strategy, geographic focus and accepted risk co-shape returns. Some companies have chosen long-term strategies, which has reflected in stable returns, while others have chosen a more aggressive approach, which has brought higher returns, but also higher risk. The geographical focus also affected the returns, as differences in economic conditions and market trends across regions created opportunities and challenges for fund managers. Higher risk has often brought higher returns, but also higher volatility, which was evident in Pershing Square's exceptionally strong stock returns.

3.2 The Risk of Investments by Joint-Stock Companies on Global Stock Exchanges and Slovenian Mutual Funds

In the investment world, there is no return without risk. Risk represents the uncertainty about future returns on an investment and is an essential part of understanding and evaluating investments. In this subsection, we focus on a tool often used in financial analyses to measure this risk: the annual standard deviation. The annual standard deviation measures the dispersion of a data set relative to the mean value of the data. The greater the standard deviation of the securities, the greater the variance between each price and the mean, indicating a greater price range (Hargrave, 2023).

The standard deviation for the S&P 500 index in the 2018-2022 period was 0.219. This value reflects the dispersion of annual returns around the mean, with a higher value indicating greater volatility and a lower value indicating more stable returns. In our case, the annual returns of the S&P 500 index are on average in a range of about 21.9% around the average annual return.

The standard deviation for the Pershing Square's stock in the 2018-2022 period was 0.275, which means that the stock's returns moved with a volatility of about 27.5% around its average annual return. The company's stock has performed highly fluctuating annual returns during the period under review, ranging between 82.5% in 2020 and -12.91% in 2022. Based on this, we can say that the investment in Pershing Square's stock is very volatile, as on the one side it means a high probability of high returns, and on the other side a higher risk, i.e. a high probability of loss.

The standard deviation for the *Berkshire Hathaway* stock of was 0.224 during the period under review, which means that the returns of the stock moved with a volatility of about 22.4% around the average annual return. Since the standard deviation of Berkshire Hathaway's stock is only slightly above the standard deviation of the S&P 500, this indicates a relatively low risk investment in the company. When you combine this with the fact that Berkshire Hathaway achieved higher returns than average returns in the capital market, and considering its relatively low risk, an investment in Berkshire Hathaway stock appears to be very attractive.

The standard deviation of the units of the *NLB Razvita Evropa Delniški* mutual fund was 0.180, which means that the returns of the mutual fund fluctuated with a volatility of approximately 18% around the average annual return during the period under review. Since this value is lower than the standard deviation of the S&P 500,

it can be argued that the mutual fund was less volatile during this period. Lower volatility generally means lower risk as the value of the investment fluctuates less. The units of the *NLB Globalni Delniški* mutual fund also had a lower annual standard deviation than the S&P 500 index. It was 0.173. This value reflects that the returns of the mutual fund fluctuated with a volatility of 17.3% around the average annual return during the period under review. Yields did not fluctuate excessively, which can be attractive to investors looking for more stable investments. Factoring in the mutual fund's low average yields (5.07%), investors would probably be more interested in an investment that tracks the S&P 500 index.

The *TRIGLAV Severna Amerika* mutual fund recorded a standard deviation of 0.223. This value reflects the volatility of the fund's return, which was approximately 22.3% around the average annual return. The value is comparable to the standard deviation of the S&P 500, which had a standard deviation of 0.219, and Berkshire Hathaway, which had a standard deviation of 0.224. The mutual fund was very similar to the stock market in terms of volatility. In addition, it managed to realize a slightly higher average annual return (8.96%) than the S&P 500 index (7.33%), thus achieving better results than the stock market.

The standard deviation of the assets of the *TRIGLAV Evropa mutual fund* amounted to 0.172 in the period under review. This value reflects the volatility of the return of the mutual fund, which was approximately 17.2% around the average annual return. The standard deviation of the mutual fund was lower than the standard deviation of the S&P 500. We can conclude that their returns were more stable and less volatile. The low average annual returns of the mutual fund (1.36%) only confirm the low volatility.

Table 4 shows the investment risks of selected shares of foreign companies and Slovenian mutual funds as well as the S&P 500 index in the considered five-year period.

Table 4: Overview of investment risks of selected Slovenian mutual funds, company shares and the S&P 500 index in the 2018-2022 period.

Stock, fund, index	Investment risk expressed in standard deviation
Pershing Square	0.275
Berkshire Hathaway	0.224
NLB Razvita Evropa Delniški	0.180
NLB Globalni Delniški	0.173
TRIGLAV Severna Amerika	0.223
TRIGLAV Evropa	0.172
S&P 500	0.219

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c, 2023f, 2023g).

Figure 4 illustrates the investment risks of selected shares of foreign companies and Slovenian mutual funds in the period under consideration.

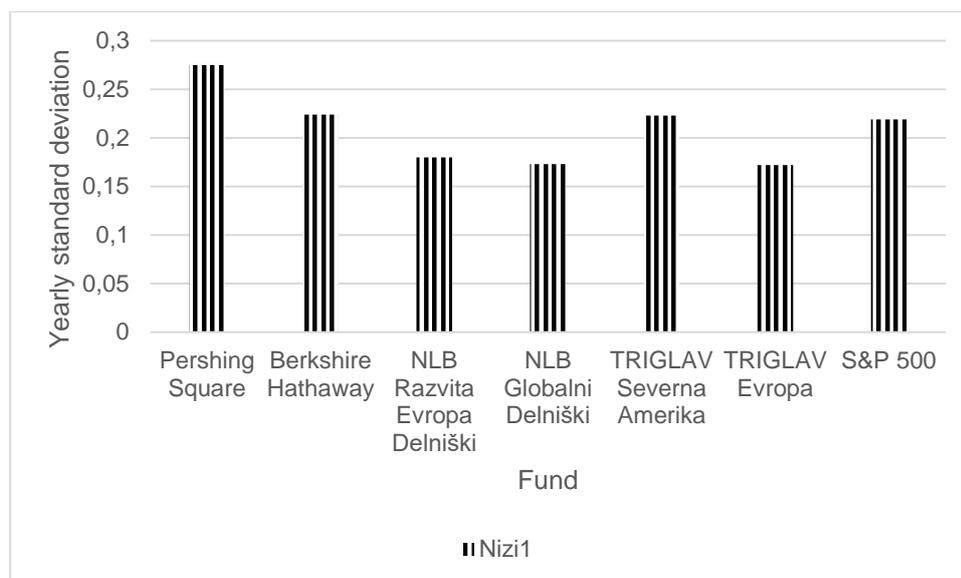


Figure 4: Graphic representation of investment risks of selected company shares, mutual funds and the S&P 500 index (2018-2022).

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c).

The analysis of the standard deviation of the shares of the selected companies and the Slovenian mutual funds provided an insight into their volatility and risks. The Pershing Square shares showed the highest volatility during the period reviewed, which reflects the high risk, but at the same time brings the potential for high returns, which was presented in detail in the previous two subsections. On the other hand, mutual funds NLB Razvita Evropa Delniški, NLB Globalni Delniški and TRIGLAV Evropa showed a lower standard deviation, which indicates lower risk with more stable returns. We can conclude that the return and risks of the fund and the company's shares are a reflection of its chosen investment strategy. While Pershing Square pursues a strategy focused on achieving high returns, which is reflected in its share price, mutual funds such as NLB Razvita Evropa Delniški, NLB Globalni Delniški and TRIGLAV Evropa chose a strategy that favours lower risk and more stable returns..

3.3 Profitability Compared to the Riskiness of Investments of Joint-Stock Companies on Global Stock Exchanges and Slovenian Mutual Funds

The Sharpe Ratio

The Sharpe ratio is a way of measuring the performance of an investment considering its risk. A higher ratio indicates an investment that provides higher risk-adjusted returns (Fernando, 2023).

For comparison, let's first look at the Sharpe ratio for companies within the S&P 500 index. The ratio was 0.24 during the period under review. For every unit of risk assumed, the S&P 500 gained 0.24 units of excess return above the risk-free interest rate. A higher Sharpe ratio means higher risk-adjusted returns, so in this case it can be argued that the S&P 500 performed relatively well compared to the risk taken.

The Sharpe ratio for Pershing Square stock was 0.71, which is much higher than the ratio achieved by the S&P 500. We can conclude that the stock has been better adjusted to risk, thus generating better results compared to the capital market. Investing in stocks managed to generate 0.71 units of excess return for every unit of risk assumed. Through analysis, we found that investing in Pershing Square shares has by far the highest average returns, is volatile and therefore riskier. The company's investment policy was riskier, but they managed to manage these risks perfectly, which allowed them to generate a large excess return. Investing in Pershing Square stock turned out to be an excellent choice for risk-averse investors in search of high returns.

The Sharpe ratio for Berkshire Hathaway stock was 0.34. The stock generated 0.34 units of excess returns for every unit of risk assumed. Although the company's stock did not achieve as high a ratio as Pershing Square's stock, it managed to generate better returns relative to the risk taken compared to the capital market (S&P 500). For the NLB Razvita Evropa Delniški mutual fund , the Sharpe ratio was barely 0.02 in the considered time period. This is significantly less than the Sharpe ratio for the S&P 500. This mutual fund generated extremely low risk-adjusted returns compared to other mutual funds and stocks of selected foreign companies. For every unit of risk that the mutual fund assumed, it generated only 0.02 unit of excess return. Considering the low average return, the mutual fund is not an attractive choice for investors.

For the *NLB Globalni Delniški* mutual fund, the Sharpe ratio was 0.17. The same as mutual funds NLB Razvita Evropa Delniški and TRIGLAV Evropa, the NLB Globalni Delniški mutual fund generated lower risk-adjusted returns compared to the S&P 500 index. For each unit of assumed risk, the mutual fund generated 0.17 units of excess return above the risk-free interest rate. Being risk-adjusted, it has underperformed the S&P 500 index. Even considering the modest returns, the findings so far suggest that the NLB Globalni Delniški mutual fund is not the best choice for investors.

The *TRIGLAV Severna Amerika* mutual fund recorded a slightly better Sharpe ratio of 0.31. The mutual fund exceeded the ratio achieved by the S&P 500 index during the period under review. For each unit of risk, the mutual fund generated 0.31 units of excess return. The mutual fund managed to generate relatively good risk-adjusted returns, but it still lagged Pershing Square and Berkshire Hathaway in both the Sharpe ratio and the average return.

The *TRIGLAV Evropa* mutual fund created the worst Sharpe ratio of all mutual funds and companies, which amounted to -0.04. The mutual fund generated negative risk-adjusted returns during the period under review. The TRIGLAV Evropa mutual fund therefore generated lower returns than the risk-free rate of return (it is a systematic risk).

Table 5 shows the Sharpe ratio, which reflects the magnitude of risk and return for selected mutual funds, shares of selected companies and the S&P 500 index.

Table 5: Display of the Sharpe ratio for stocks of selected companies, mutual funds and the S&P 500 index in the 2018-2022 period.

Fund, stock, index	Sharpe ratio
Pershing Square	0.71
Berkshire Hathaway	0.34

NLB Razvita Evropa Delniški	0.02
NLB Globalni Delniški	0.17
TRIGLAV Severna Amerika	0.31
TRIGLAV Evropa	-0.04
S&P 500	0.24

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c, 2023f, 2023g)

Figure 5 visualizes the Sharpe ratios as shown in Table 5 and represents the return-to-risk ratio for selected mutual funds and companies.

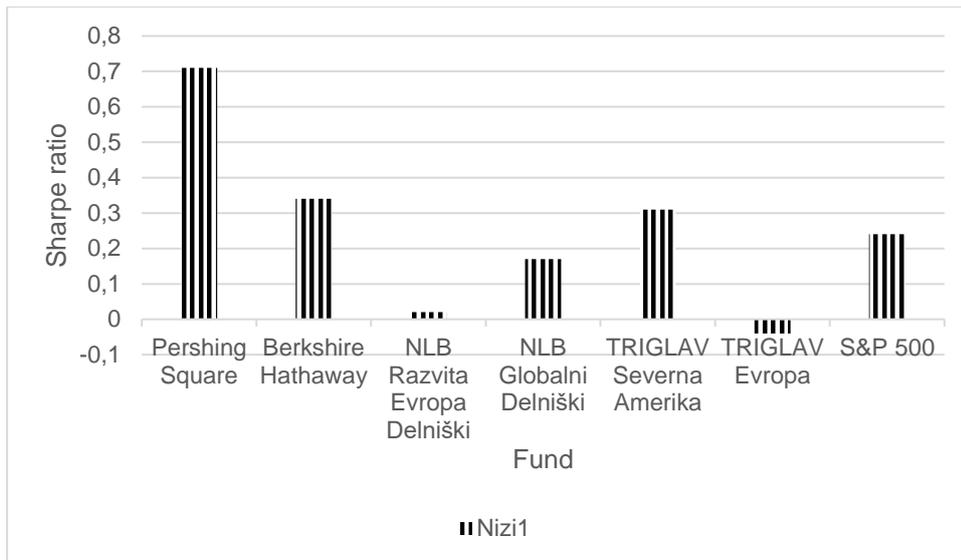


Figure 5: Display of the Sharpe ratio for stocks of selected companies, mutual funds and the S&P 500 index.

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c).

In summary, the analysis of the Sharpe ratio for the stocks of the selected companies, mutual funds and the S&P 500 index offered a thorough insight into their return relative to the risk assumed. The differences in ratios showed a clear divide between individual investment strategies of mutual funds and companies. The shares of Pershing Square have been the best performers in terms of achieving risk-adjusted returns, while some mutual funds, such as TRIGLAV Evropa, have shown less favourable results. Different investment management strategies, from more dynamic to more conservative, reflect different risks and returns. From the perspective of an investor seeking the optimal combination of return and risk, this analysis helps identify potential opportunities and pitfalls within available investment options.

The Monte Carlo Simulation

A Monte Carlo simulation is based on random sampling to generate numerical results and to simulate the range of possible outcomes for an uncertain event. The Monte Carlo simulation results are not completely accurate. The results shown are only simulated and do not exactly represent the predicted results, but serve as a tool to evaluate different possible scenarios. Also, a Monte Carlo simulation assumes constant returns, which is not the case in reality (Kenton, 2023).

In our example, we run a Monte Carlo simulation that considers an annual investment of \$6,000 over a period of 40 years (2022-2062). With this input, we model a regular annual investment or payment into an investment or portfolio. In the simulation, we run 10,000 scenarios for each stock of the selected company and unit of the mutual fund in order to evaluate a wide range of potential outcomes.

The Monte Carlo simulation results are shown in Table 6.

Table 6: Combined Monte Carlo simulation results for selected mutual funds, corporate stocks and the S&P 500 index.

Stock, fund, index / Percentile	5 %	25 %	75 %	95 %
PSH.AS	3,934,025	14,626,639	89,513,017	326,300,383
BRK-A	290,724	761,113	3,041,195	8,812,753
NLB Razvita Evropa Delniški	102,555	191,997	491,570	1,041,253
NLB Globalni Delniški	182,646	357,329	958,234	2,047,977
TRIGLAV Severna Amerika	250,877	644,925	2,578,724	7,260,077
TRIGLAV Evropa	92,492	162,139	385,506	766,662
Index S&P 500	183,454	441,362	1,650,003	4,384,542

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c, 2023f, 2023g)

The PSH.AS stock consistently shows high ranging from \$3,934,025 at the 5th percentile to a whopping \$326,300,383 at the 95th percentile. The BRK-A stock boasts values ranging from \$290,724 at the 5th percentile to \$8,812,753 at the 95th percentile. Widely recognized as a reflection of the overall health of the US stock market, the S&P 500 provides values ranging from \$183,454 at the 5th percentile to \$4,384,542 at the 95th percentile. The TRIGLAV Severna Amerika mutual fund shows wide dispersion with final investment values between \$250,877 at the 5th percentile and \$7,260,077 at the 95th percentile.

On the other side of the spectrum are mutual funds such as NLB Razvita Evropa Delniški, NLB Globalni Delniški and TRIGLAV Evropa, which show a more stable and balanced final value of investments with smaller differences between values at the 5th and 95th percentile.

The Monte Carlo simulation revealed the dynamics of long-term investments in shares of the selected companies and mutual funds. Namely, those who chose to invest long-term reaped benefits regardless of short-term fluctuations. The long-term approach allowed the capital to develop and grow without exposing the investment to momentary market reactions. The simulation confirms the fact that time and patience are essential factors in building a successful investment portfolio and reinforces the mindset that long-term investment patience often brings more stable and positive results.

The differences in the investment strategy are also perfectly visible. Pershing Square's stock showed high investment closing values. The company pursues a more

aggressive strategy aimed at seeking high returns, often with greater risk. On the other hand, Berkshire Hathaway, known for its conservative strategy with a focus on long-term value, showed lower but still high final investment values. Mutual funds TRIGLAV Evropa, NLB Razvita Evropa Delniški and NLB Globalni Delniški showed lower final investment values, which reflects a different approach to the investment strategy.

The CAPM Model

The CAPM model (capital asset pricing model) is an idealized representation of how financial markets value securities. They determine the expected returns on capital investments, taking into account the risk measured by the standard deviation. The CAPM model states that the riskier the stock the higher its expected return (Marotta, 2012).

A stock's beta measures the movement of the value of a particular investment compared to the movement of the S&P 500 index (Marotta, 2012).

Table 7 shows the results of the CAPM model.

Table 7: Display of Beta and CAPM values for selected mutual funds, company shares and the S&P 500 index.

Indicator	PSH.AS	BRK-A	NLB Razvita Evropa Delniški	NLB Globalni Delniški	TRIGLAV Severna Amerika	TRIGLAV Evropa
BETA(β)	0.9700	0.8700	0.6274	0.4631	0.3974	0.5437
CAPM	8.8 %	8.4 %	7.3 %	6.6 %	6.3 %	7 %

Source: NLB Skladi (2023b), Triglav Skladi (2023c), Yahoo Finance (2023c, 2023f).

The beta coefficient (β) for Pershing Square (PSH.AS) is 0.97. The return on this company's share moves in line with the return on the capital market, represented in our case by the S&P 500 index. The CAPM model shows the highest expected return among mutual funds and shares, a return of 8.8%.

The displayed expected return is far below the calculated average annual return on the company's stock, which was 21.74% over the last five years. The CAPM model takes into account systematic risk, which is measured by beta, but not non-systematic risk or specific characteristics of investments and their management (Kenton, 2023). The company's stock had a high average standard deviation (27.5%), which is not taken into account by the CAPM model. The exceptionally high average annual return over the past five years may therefore be the result of non-systematic risk and other factors. Consequently, the future return shown by the CAPM model for the PSH.AS share may not be the most realistic. Furthermore, the CAPM model assumes that financial markets are perfectly rational and efficient and therefore all information is immediately and fully incorporated into investment prices (Kenton, 2023). Pershing Square exploits market irrationalities including the irrational behaviour of other investors, delays in incorporating information into stock prices, and other forms of market inefficiency. Therefore, the CAPM model cannot

accurately estimate the future profitability of the PSH.AS share, since the company operates exactly in the way the CAPM model does not take into account.

The beta coefficient for Berkshire Hathaway (BRK-A) is 0.87. Therefore, the return on the share is slightly less sensitive to market movements than the S&P 500 index. According to the CAPM model, we can expect an annual return of 8.4%.

Similar as Pershing Square, Berkshire Hathaway also exploits market irrationalities. The CAPM model does not take into account the specifics of Berkshire Hathaway's strategy, so the model cannot be completely reliable and may underestimate expected returns. Berkshire Hathaway's investment policy is also highly diversified. A high degree of diversification in certain cases leads to a lower beta value of the company's stock, which in turn reduces the expected return on the stock according to the CAPM model (Kenton, 2023).

NLB Razvita Evropa Delniški - a mutual fund managed by NLB Skladi - invests mainly in the developed Europe with part of the assets also intended for developing European markets (NLB Skladi, 2023c).

The beta coefficient per unit of mutual fund assets is 0.63, which means that the mutual fund's performance is not that strongly related to the general movement of the market. Using the CAPM model, we can conclude that the expected return could be 7.3%.

NLB Globalni Delniški - a mutual fund managed by NLB Skladi - invests globally with a focus on developed markets, but occasionally also includes investments in developing markets (NLB Skladi, 2023a).

The mutual fund's historical daily unit prices show a beta value of 0.46. The return of the mutual fund can therefore follow the market movement like the S&P 500 index. Based on the CAPM model, the expected return would be 6.6%.

TRIGLAV Severna Amerika - a mutual fund managed by Triglav Skladi - invests in the shares of the largest companies in North America (Triglav Skladi, 2023b).

The unit of mutual fund assets has a beta coefficient of 0.40. The return of the mutual fund follows the market movement less than the S&P 500 index. According to the CAPM model, a return of 6.3% could be expected.

TRIGLAV Evropa - a mutual fund managed by Triglav Skladi - invests in shares of established European companies (Triglav Skladi, 2023a).

The beta value of the asset unit is 0.54, which indicates that the return of the mutual fund is less sensitive to market movements than the S&P 500 index. According to the CAPM model, we can expect an annual return of 7%.

In conclusion of this subsection, we can write that the CAPM model is useful and effective for understanding risks and returns in the context of systematic market risk. However, its use is best in combination with other tools and analytical approaches that can better include the complexity and dynamics of individual investments. This subsection provides insight into the benefits and limitations of the

CAPM model, but is also important for understanding the big picture when evaluating investment opportunities.

Conclusions

In the research, we examined in detail the investment strategies of three globally recognized successful investors, Warren Buffett, Bill Ackman and Chamath Palihapitiya, and compared them with the investment strategies of Slovenian mutual funds and the capital market. We tested four research hypotheses.

Research shows that the ability to monitor and assess a company's intrinsic value can lead to extraordinary returns. Using fundamental analysis, Buffett, Ackman and Palihapitiya found undervalued companies, invested in them and made money by increasing their market value.

We confirm the first hypothesis *H1: Proper assessment and monitoring of the company's future intrinsic value enables above-average investment returns.*

The financial analysis confirmed the fact that the capital fund's profitability and risk are a reflection of its chosen strategy. It turned out that the ability of Pershing Square and Berkshire Hathaway to achieve above-average returns also partly stems from the acceptance of greater risks, which both companies managed by diversifying their investments. The NLB funds followed more conservative strategies, which is why they generated lower but more stable returns. The Sharpe ratio showed the importance of risk management. Pershing Square and Berkshire Hathaway can accept more risk because they know how to manage it better, while for example the NLB funds generate relatively low returns per unit of accepted risk. We confirm the second hypothesis *H2: The fund's profitability and risk are a reflection of its chosen investment strategy.* Funds willing to accept more risk often aim for higher returns, while more conservative funds focus on achieving more stable but lower returns.

Time and patience are extremely important in investing. All three investors are well-aware that to achieve truly high returns, it is necessary to take a strategic, long-term view of investments. Such thinking is reflected in their approach of not simply buying stocks but seeing themselves as business owners. They focus on the long-term performance of the company rather than on the short-term market fluctuations, which can lead to more stable and potentially higher returns in the long run. They warn that a short-term view leads to extremely risky speculative investments, which confirms the third hypothesis *H3: The most important factors in investing are time and patience.*

In the financial world, opinions on the accuracy of stock market values remain divided. Some financial experts believe that markets always reflect all available information consistent with the efficient market hypothesis, which states that it is impossible to consistently generate above-average returns. Nevertheless, it should be noted that Buffett, Ackman and Palihapitiya, with their good understanding of individual companies and their excellent knowledge of how the stock market works, managed to identify investment opportunities well. Above-average returns were generated only after a few years until the market recognized the potential and value of these companies. We partially confirm the fourth hypothesis *H4: The stock market does not always reflect the real value of an individual company, so it is important to critically evaluate every decision and not blindly follow market trends.*

At this point, we should also mention the limitations we encountered during the research. These relate mainly to the empirical part. The first limitation stems from the non-random sample size. We limited the research to two large foreign joint-stock companies, whose shares are listed on world stock exchanges, and to a few Slovenian mutual funds. We did not include Slovenian joint-stock companies, for example the so-called blue chips, and we did not consider all Slovenian mutual funds, for example the Generali Investments mutual fund. The research could cover a longer period, e.g. a 10-year period. We also point out the limitation of access to complete information regarding the presented strategies and the possible bias in the interpretation of their performance. Additional limitations include the lack of quantitative analysis that could better quantify the effectiveness of the strategies, while time constraints prevent a full assessment of the long-term performance and sustainability of these strategies. We also emphasize that our analysis of returns and risks does not cover all relevant factors, such as macroeconomic, regulatory conditions and taxation. We must definitely take these limitations into account when interpreting the presented findings of our research.

It would be useful to include other well-known investors in future research. It would be interesting to include investors with different views and approaches to making their investment decisions and to examine how their strategies perform in different market conditions.

It would also make sense to analyze the reasons why Slovenian mutual funds do not achieve returns that would be closer to the returns of the investors that we present in this paper. The goal would be to determine whether there are specific market or regulatory factors that, with their limitations, affect the profitability of Slovenian mutual funds. The research could also include an analysis of investment approaches used by Slovenian mutual funds.

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“HOW DOES SOCIAL ENGINEERING EXPLOIT EMPLOYEE WEAKNESSES?”

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Abstract

In the world of information security, the employee is an important factor. This ranges from the so-called victim bias (the belief “it cannot happen to me”) to the key role of emotions in information fraud. The importance of neurodiversity is also important here: how employee’ cognitive abilities influence reactions to various incidents in information security. Knowledge of information behaviour belongs to an interdisciplinary field that includes psychology, sociology, computer science and neuroscience. Attackers are increasingly attacking employee, not technical devices because this is more efficient and cheaper. Employee (with all their needs, motives, attitudes and internal personality factors) are critical to the information system. It interacts with the system, detects and monitors threats, makes errors and corrects errors. A malicious error is an employee decision and cannot be eliminated from the information system, but preventive measures and procedures can reduce its harmful effect. With what opinions, attitudes, beliefs and values does the employee identify? In the work environment, an employee forms behavioural intentions towards protecting the organization’s data and information under the influence of attitudes towards information security, subjective norms and perceived behavioural control.

Key Words

Information security, psychology, employee.

INTRODUCTION

Social engineering is a method of psychological manipulation by which attackers trick employees into revealing sensitive information, performing certain actions, or granting unauthorized access to systems. It is a deception technique that exploits human nature, such as trust, fear, or curiosity, rather than relying on technical vulnerabilities.

The article discusses the importance of psychology in the world of information security. From the so-called victim bias (the belief “it cannot happen to me”) to

the key role of emotions and perceptions in information fraud. The importance of neurodiversity is also important here: how an employee's cognitive abilities influence reactions to various incidents in information security. Knowledge of information behaviour belongs to an interdisciplinary field that includes psychology, sociology, computer science, neuroscience, etc. It studies how employees operate, communicate and behave in digital environments.

Attackers attack employees more than technical devices because it is more efficient and cheaper. The influence of employees on an information system is one of the most unreliable and unpredictable factors. Therefore, it represents a constant threat to the system and should not be underestimated. Employees (with all their needs, motives, attitudes and internal personality factors) are critical to the information system. They interact with the system, detect and monitor threats, make mistakes and correct errors. A malicious error is an employee's decision and cannot be eliminated from the information system, but we can reduce its harmful effect with preventive measures and procedures. The employee role is negative in causing accidental or malicious errors and positive in eliminating errors (Polič, 1998).

What are the employee's role, and with which opinions, attitudes, beliefs, and values does he/she identify? In this environment, employees, under the influence of attitudes towards information security, subjective norms and perceived behavioural control, form behavioural intentions towards protecting company data and assets. It should be taken into account that an employee's attitude towards a specific behaviour depends on his/her belief about the probability and possible consequences of an incident (Bertoncelj, 2000).

The results of psychological experiment research demonstrate that employees are not exactly the best estimators of the probability of an incident and that, in individual cases, they systematically violate the principles of rational decision-making when dealing with uncertainty.

Criminals use numerous social engineering techniques in both the physical and information security worlds. The advent of artificial intelligence will make deterring and preventing such attacks even more difficult. Generative artificial intelligence will continue to learn. It will be used by smart criminals who want to obtain business and personal data or assets from an employee. The process of achieving effective information security among employees begins with awareness and ends with changes in behaviour, and this process includes an important mediating factor of information security judgment and decision-making.

THEORY

The literature on employee behaviour focuses on organizational behaviour, motivation, teamwork, organizational culture, leadership, safety, and other aspects of the work environment. The psychology of judgment is one of the most productive areas of behavioural science. Nobel laureate Kahneman (2002, 2011) developed an influential intuitive and rational judgment theory. Based on his theory, an employee uses two types of thinking: intuitive thinking with different cognitive biases and rational thinking with more precise judgment. Specifically, intuitive thinking is associative, involves little overt effort and conscious thought, and is mainly related

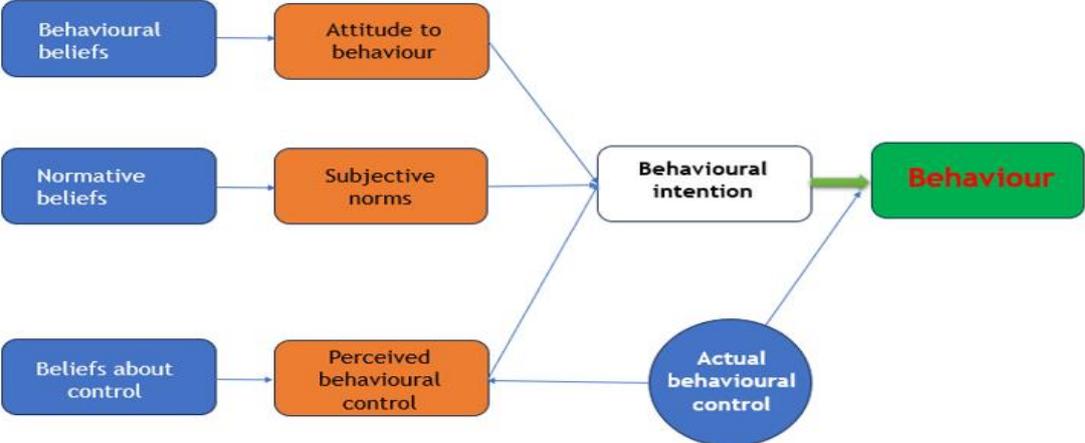
to emotions and past experiences. On the other hand, rational thinking is slow, laborious, rule and process-based, intentionally controlled, and involves logical, hierarchical, and causal mechanical processes.

Organizational culture influences employee behaviour and company performance. Schein (2017) emphasizes that leaders shape and maintain organizational culture through values, norms, and beliefs. Sinek (2014) adds that successful leaders build trust and collaboration, fostering innovation and productivity. Effective teamwork and collaboration are key to company success. Lencioni (2002) identifies five dysfunctions that can inhibit team performance: lack of trust, fear of conflict, lack of commitment, avoidance of responsibility, and inattention to results. Edmondson (2018) emphasizes the importance of psychological safety as a key factor in successful teams, as it allows employee to express ideas and mistakes openly without fear of negative consequences. Grant (2013) discusses the impact of selflessness and collaboration on company success. Pink (2009) focuses on intrinsic motivation and explains why autonomy, mastery, and meaning are key factors in employee success. Sinek (2014) discusses the importance of leadership based on trust and collaboration. Edmondson (2014) explores psychological safety in the workplace and its impact on innovation and collaboration. Robbins and Judge (2019) and Schein (2017) have investigated how organizational culture and leadership shape employee behaviour and their contribution to company performance. O'Keefe (1990) investigated how persuasion works and which strategies and techniques are most effective in changing the attitudes and behaviours of employee. He defines persuasion as a process in which one person influences the beliefs, attitudes, or behaviours of another person. He discusses key theories such as the two-stage process theory and the cognitive dissonance theory. He analysed factors such as the credibility of the speaker, emotional and rational arguments, and social influence, which affect the effectiveness of a message. He emphasized that persuasion is a complex process in which there are not always clear-cut rules, but rather that the effectiveness of a message depends on many factors such as the context, audience, and form of communication.

Of particular interest is Klein (2009), who investigated how employees make decisions in the real world, where rules and algorithms are often insufficient. The author criticizes traditional approaches to decision-making, which are based on rigid rules, models and analytical procedures, and emphasizes the importance of intuition, experience and flexibility. Classic decision-making models, which are based on collecting all the data, analysing alternatives and calculating the best options, often do not work in dynamic and complex environments, where employees often have to make quick decisions with incomplete information. Although past experience helps in decision-making, over-reliance on it can lead to errors if circumstances change. It is important to maintain flexibility and the ability to question one's own assumptions. In the real world, we often cannot fully control events, so we must accept uncertainty and develop the ability to adapt. Too many rules and procedures can reduce the ability to adapt and be creative.

Which factors are most important for understanding and predicting behaviour? Unfortunately, there is no clear and universal answer to this question yet. The typical starting point of the theories discussed is that we must always look for the causes of behaviour in the interaction between the psychological characteristics of the employee and the characteristics of the environment or situation.

Table 1: Integral model of individual behaviour (Musek, 1993).



What determines employee behaviour? The study of understanding and, thus, predicting behaviour is used in various areas of social life and for various purposes. There are many psychological theories and also different definitions that describe the relationship between attitude and behaviour and the determinants of behaviour, such as personality traits, unconscious desires, drives, aspirations for self-actualization, etc.

It is interesting to note that research on the theory of self-awareness assumes that an individual is not necessarily always internally consistent. We should even consider a potentially very inconsistent person (Musek, 1993). An explanation of the model is beyond the scope of this article.

Information security is the responsibility of every employee. It is important that the employee takes responsibility rather than shifting it to others. Key challenges are the lack of awareness and the need to simplify messages, as employees are looking for specific information. Information security affects both the personal and professional lives of employees, so it is crucial to deal with it at both levels. It is important not to cause frustration to employees by raising security awareness. Instead, we need to make employees aware that they are taking responsibility for their own security without unnecessary fear of consequences (Bertoncelj, 2001).

METHODS

We will analyse some theoretical foundations and findings of other research on information security from a broader perspective of social engineering. Using a phenomenological approach, we will explore an employees' experiences with a weakness in security behaviour. We will focus on the subjective experience of the employees in the context of good security practices.

The research will seek to understand how employees experience and understand situations where poor safety behaviour and incidents occur in the workplace. In this context, we ask the following research question: "How does social engineering exploit employees' weaknesses?" The sub-questions are: "How do employees

experience situations where safety behaviour is poor, and what factors influence this?” We will formulate proposals for improving safety culture based on the analysis and good practices.

FINDINGS

SOCIAL ENGINEERING

Attackers manipulate employees to obtain work and personal information and access information systems or company assets. Some examples are:

- phishing—fake email or SMS messages that trick users into entering their passwords or other information,
- pretexting—the attacker impersonates someone else (e.g., a co-worker, official, or technical support) and makes up a story to obtain confidential information such as passwords, personal data, or financial information,
- tailgating—the attacker follows an authorized employees through security doors or access points (e.g., entering a building without a card by pretending to be an employee or visitor),
- baiting—the attacker uses bait (e.g., an infected USB stick left in plain sight) or the promise of something attractive (e.g., a free software download) to convince the employees to perform an action that will later enable the intrusion,
- whaling is a unique “spear phishing” form where the targets are management (e.g., directors, CFOs). Attackers send very convincing email scams to gain access to confidential data or initiate financial transactions.

Each of these attacks exploits the employee's personalities traits, trustworthiness, and carelessness, so it is important for employees always to be cautious when interacting with unknown individuals.

We can have the most advanced technological solutions for information and cybersecurity. However, if an employees do not understand the security risks or act responsibly, the system is vulnerable.

Psychological foundations of manipulation

They are based on understanding human psychology, behaviour, motivation, and emotional reactions. Manipulation is a process in which an individual or group uses various tactics to influence an employee, often without their knowledge or against their best interests. The key psychological foundations of manipulation are:

- understanding human needs and weaknesses (manipulators target the employees' basic needs (security, belonging, self-esteem) in order to achieve control (Musek, 2000),
- emotional weaknesses: fear, insecurity, guilt, and doubt are often used for manipulation,
- the need for affiliation: employees accept influence to feel connected to colleagues,

- exploiting cognitive biases (employees are more likely to follow advice or orders from others they perceive as authorities),
- if employees see most others do or believing something, they tend to imitate it,
- the employees feel obligated to return the favour, which the manipulator can abuse.

Emotional manipulation

- Gaslighting: directing the employees to doubt their perception of reality,
- the manipulator may induce feelings of guilt in order to control the employees' behaviour,
- flattery and apparent concern are used to gain trust before the manipulator takes advantage of the situation.

Perception and control of information

- Manipulators often provide selective information to shape the perception of the situation,
- reframing the situation so that it appears favourable to the manipulator,
- intentionally spreading false or distorted information (disinformation) to achieve a goal.

Manipulation techniques used

- Fear and threats and creating a sense of danger in order to force the employees to behave in a certain way,
- creating pressure to make quick decisions without sufficient thought,
- passive aggression: users of this tactic indirectly cause feelings of guilt or frustration in others,
- manipulators often use techniques that create dependency, whether through emotional support, financial control or social isolation, to maintain power over the employees.

Employees behaviour in the company

Employees behaviour refers to how they act, interact, and responds to work tasks, co-workers, management, and the organizational environment. This behaviour is influenced by many factors, including motivation, organizational and safety culture, working conditions, and personal values. It refers to the following factors:

Individual factors

- Personality—influences how an employee communicates, solves problems, and copes with stress (Museum, 1993),
- motivation—theories such as Maslow's hierarchy of needs, Herzberg's two-factor theory, and self-determination (Ryan & Deci, 2000) explain why an employees works with greater or lesser enthusiasm,
- attitudes and values—employee who value teamwork will be more willing to participate in group projects.

Organizational factors

- Leadership—leadership style (authoritative, democratic, laissez-faire) strongly influences employee behaviour),
- organizational culture—in a company with open communication and trust, employee is more innovative and engaged,
- reward system— fair rewards (salary, bonuses, recognition) encourage positive behaviour,
- working conditions—a pleasant working environment reduces stress and increases productivity.

Social and situational factors

- Relationships with colleagues—good relationships strengthen teamwork, while conflicts reduce productivity and, among other things, the attitude towards information security,
- fairness and transparency—if an employee perceives honesty in the company, he is more motivated and loyal.

EMPLOYEES WEAKNESSES

Employees weaknesses in social engineering are key to making this manipulation work. Attackers exploit employees' psychological, behavioural, and financial weaknesses to achieve their goals. Warning signs of potential problems are many and varied, such as job frustration, resistance to authority, serious illness or death in the family, debt, mistakes, accidental slips, reckless behaviour, genuine ignorance, poor judgment, misuse of information, misuse of business objectives, poor attitude to risks, lack of coordination of activities, etc.

Some employees have difficulty adapting to new situations or changes in work organization, rigid following of rules can prevent creativity and innovative problem solving, employee with little experience often cannot rely on intuition, which can lead to wrong or slow decisions, some employees are overly cautious and avoid taking responsibility because they fear the consequences of wrong decisions, fear of mistakes can lead to a lack of initiative and innovation, poor communication skills can cause misunderstandings and reduce the effectiveness of teamwork, some employees rely too much on formal guidelines and are not capable of making independent decisions in the event of an incident, ineffective prioritization can cause employees to focus on less important tasks.

Some of the key weaknesses of an employees are:

- lack of awareness (often not sufficiently familiar with social engineering tactics and does not know how to recognize suspicious requests or unusual requests),
- overconfidence (people are naturally trusting and want to help, primarily if someone convincingly addresses them),
- fear of authority (if someone introduces themselves as a security engineer or other important employees, their identity is often not verified due to possible negative consequences if they refuse the request),
- routine (the employees operate according to habits and often does not verify dubious requests that are not part of the business; the employees' fatigue is exploited to break into the system),

- emotional manipulation (attackers often play on emotions such as a sense of urgency, fear or sympathy),
- poor password selection practices (using weak or identical passwords for multiple systems, sharing passwords with colleagues),
- insufficient identity verification (lack of verification of the caller's authenticity, emails or company visitors, clicking on suspicious links or opening unknown attachments without checking).

The most vulnerable employees

The most critical part of information security are all employees, as any employee can be an entry point for information attacks. However, some employees profiles are particularly vulnerable or crucial to a company's information security. The most critical groups of employees are:

- management and administration (targeted by attackers due to access to confidential data and financial assets, are a frequent target of attacks, have less technical knowledge about security),
- finance and accounting employees (targeted by spear-phishing attacks that try to obtain fraudulent transfers),
- IT and system administrators (have the most significant access to networks, data, servers and passwords; attackers can gain administrator rights over the entire system and privileged accounts, following the principle of least privilege),
- human resources (attackers send fake job applications with infected files attached),
- all employees who communicate with external parties (support, sales, marketing) (often receive emails from unknown sources and may inadvertently open suspicious attachments or links, attackers pose as customers or business partners, and risk of disclosure of confidential information through public channels-networks).

Behaviour change

Changing employees behaviours is key to improving information security in a company. Technical security solutions are important, but employees remain among the most significant vulnerabilities. Employees awareness and education are, therefore, essential to reducing the risk of security incidents. Changing employees behaviours in the area of information security requires a combination of education, clear rules, technological support, and the promotion of a positive information culture. Companies that invest in these elements reduce the risk of information attacks and provide a safer working environment.

Changing employees behaviours in information security is challenging as employees have already formed personalities, have their career paths, often resist change, underestimate risks, or lack experience, which leads them to be careless. The main challenges include:

- awareness and education (regular awareness, instead of one-off workshops, is more effective through shorter, practical modules, use of artificial intelligence, working in the cloud, misuse of QR codes, real-life examples and simulations, employees learn better through real-life examples,

adaptation to different learning styles—visual materials, interactive quizzes and short videos),

- promoting a security culture (leadership as an example, positive reinforcement—instead of punishing mistakes, it is better to encourage correct security practices with praise and rewards, the company can introduce a reward system for security—responsible behaviour, security should be integrated into everyday work, not just as an additional burden),
- simplifying security practices (using simple and understandable guidelines, automating security processes—using password managers, single sign—on and multi—factor authentication to reduce the need to remember complex rules, frequent security and technical updates),
- the principle of least privilege (an employee should only have access to the data and systems that he or she needs for work),
- measurement and improvement behaviour (monitoring progress—employees survey and analysis of responses to attack simulations, direct feedback on incorrect or risky actions improves long—term behaviour),
- security culture (information security is not only the responsibility of the IT department but of the entire company, measuring the success of security programs with key success indicators),
- developing adaptability by encouraging employees to learn from different scenarios and experiment with different solutions,
- strengthening intuition by providing hands—on experience and mentoring,
- encouraging open communication to reduce misunderstandings and improve team collaboration,
- learning to manage failure with a culture that allows new ideas to be tried without fear of punishment,
- other aspects are also important (technology, processes, rules, work organization), but without a security—conscious employees, no protection will be adequate,
- lack of incentives (if the company does not reward secure behaviour, the employee will not consistently perform it).

DISCUSSION

Emphasizing behavioural change requires psychological, cultural, organizational, security, and technical transformation. The key is to create a work environment that rewards good behaviour and does not punish mistakes. We must focus on going beyond technical solutions and building an employees firewall that should be the company's first line of defence.

Criminals use numerous social engineering techniques in both the physical and information security worlds. The advent of artificial intelligence will make deterring and preventing such attacks even more difficult. Generative artificial intelligence will continue to learn. It will be used by clever criminals who want to obtain sensitive data or assets from employees. The process of achieving effective information security among employees begins with awareness. It ends with changes in behaviour, and this process includes an important mediating factor of judgment and decision—making about information security and risks.

Social engineering, in which official information is obtained and misused from an Internet user through manipulation, poses a serious threat to the information environment. Employees are a more straightforward “target” than hardware attacks, and social engineers are becoming more and more professional. They conduct extensive research on their victims before the attack, are capable of psychological manipulation, communication, and recognition of emotions and behaviour, and therefore quickly gain the trust of employees. As a result, companies must increase employees security awareness. Many different psychological and social factors influence employees behaviour regarding information security.

For lasting behaviour change, it is crucial for employees to understand the importance of information security, have clearly defined guidelines, and feel included in the company’s security culture. The more straightforward and more accessible security is, the more likely it is that employees will follow it.

Risk assessment is further complicated by excessive confidence in the correctness of one’s judgment. Employees too often have excessive trust in their judgment and even incorrect judgment. The psychological basis for this is insensitivity to the shortcomings of the assumptions on which their judgment is based. No factor in judgment is more decisive than excessive self–confidence. General knowledge causes a relatively high level of excessive self–confidence, but the opposite also applies.

The time we live in is not entirely favourable to planned incident prevention. Development problems in society, conflicts of interest and declining financial resources for survival and prevention raise interesting questions about the security of information assets as a business expense. We should not allocate more financial resources to measures and procedures intended to protect against risks or manage losses than the expected losses if information assets were at risk or if an incident occurred. Ensuring security is cost–effective if the reduction of risks is balanced with the costs of protecting against risks. The greater the value of information assets, the greater the need for control measures and procedures to protect them.

Ultimately, investing in measures and procedures to protect information assets is the price that a company pays for risky activity from the perspective of possible incidents. We can say that the company will have to pay once. The company can choose the method of payment. It can pay in a way that is normal, correct, and, in the developed world, also business–like, that is, by optimally investing financial resources in preventive security and protection measures and procedures or in an unpredictable way (without a planned approach and investment), but it will have to be paid. The security and protection of information assets in a company must pay off, not just be paid for.

CONCLUSIONS AND IMPLICATIONS

Every employee is responsible for information security, which is only as good as its weakest link. This is also an often–overlooked part of the company’s security system. The research question shows that emphasizing the human factor requires a cultural, psychological and security transformation that refers to changing employee

behaviour. Which factors are the most important for understanding and predicting behaviour? Unfortunately, there is no clear and universal answer to this question yet. Numerous statistical analyses have confirmed the hypothesis of a greater connection between behaviour and attitudes that are formed based on direct experience. This means that no absolute “internal rules” or conditions must be met for an employees to always behave consistently with them. The level of information security largely depends on the employees’ motivation and affiliation with the company because this means self-protective behaviour for the company’s benefit and timely elimination of subjective disruptive elements in work processes (Bertoncelj, 2000). No matter how trained the supervisory and security personnel are, this cannot be replaced by any security organization and technique.

Social engineering exploits employees weaknesses by exploiting traits such as trust, curiosity, fear, desire to help, or pressure from authority. Attackers use manipulative tactics to convince employees to disclose sensitive business information, provide unauthorized access, or perform actions that could jeopardize the company’s financial operations and security. Employees must take responsibilities rather than shifting it to others. Key challenges include a lack of awareness and engagement and the need to simplify messages as employees seek specific information. Information security affects an employees’ personal and professional lives, so addressing it at both levels is crucial. We can have the most advanced technological solutions for information security, but the entire system is vulnerable if an employees does not understand security risks or act responsibly. It is important not to create frustration for employees by raising awareness. Instead, we need to empower them to take responsibility for their security and the company’s security without unnecessarily scaring them about the consequences of an incident.

Social engineering, in which business information and company assets are obtained and misused from an employees through manipulation, represents a serious threat in the information environment. Employees represent a more straightforward “target” than attacks on hardware and communication computer equipment, and social engineers are becoming increasingly professional. They conduct extensive research on their victim before the attack, are capable of psychological manipulation, communication, and recognition of emotions and behaviour, and therefore gain the employee’s trust. Security breaches are common in companies, and many violations are attributed to employee error or negligence.

Therefore, in a constantly changing world, protecting information assets must be considered an important priority. Information security should not be justified by the probability of something happening but by the possible consequences. It is a simple question: Can a company afford the “luxury of information ignorance” on the one hand and the loss of information assets on the other?”

For a lasting behaviour change, it is crucial that the employees understand the importance of information security, has clearly defined guidelines and feels included in the company’s security culture. The more simple and accessible security is, the more likely the employees will genuinely comply. We cannot “boil the ocean” to reduce all information risks. However, we must feel calm, knowing we are attentive to managing the most critical and high risks while understanding the company’s risk appetite. The key is to create a work environment that rewards correct behaviour and does not punish mistakes.

We are all vulnerable to data exploitation because we are online, and legitimate companies use the same persuasion techniques cybercriminals use to collect our data and subcontractors. Remember the Cambridge Analytica scandal?

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THE DEXI MODEL FOR CONSISTENCY ASSESSMENT OF DIGITAL FORENSIC INVESTIGATION

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Abstract

The article presents the fundamental principles of digital forensics and the necessary conditions for evidence to be valid in court proceedings, and a developed software model for assessing the consistency of the material and procedural part of a forensic investigation.

Computer forensics can be defined as the process of identifying, securing, analyzing, and presenting evidence in electronic form in a manner that is legally acceptable. It follows from the above definition that there are certain rules and boundaries that must be followed when conducting a digital investigation.

The method for multicriteria decision making was used to develop a qualitative model for assessment of digital forensic investigation with DEXi software. The developed model is intended to support the assessment of the compliance of a digital forensic investigation with professional and legal requirements.

Key Words

Digital forensic; forensic principles; digital evidence; rules of evidence; decision making; DEXi.

INTRODUCTION

With the accelerated digitalization of society, information technology has become so intertwined with everyday life that it is difficult to find a case of investigating a security incident or criminal procedure where digital forensics would not be necessary. Despite the development of forensic tools, knowledge of hardware and software tools alone is not enough to ensure that the procedure is forensically correct and the evidence is valid in court. Digital forensics refers to the investigation of digital evidence for the needs of legal and other procedures, i.e. to search for evidence among data in electronic form that is reliable and usable in court. Thus, in addition to the technical knowledge of the forensic investigator, knowledge of the correct forensic procedure, knowledge of the principles of digital forensics and legal requirements is also essential. An additional challenge is the fact that, unlike

evidence in the material world, evidence in electronic form is generally less durable and more easily falsified. It follows from the above facts that the investigator is also an important element of a complex investigation system; he must be professional, methodical, systematic, precise and persistent. In addition, he must be skilled in presenting the established facts and circumstances and the collected evidence, and must have appropriate written and verbal competencies. A digital forensic investigation therefore consists of various steps, each of which is strictly defined both in terms of content and procedure.

The success of an individual investigation depends on taking into account all of the listed elements, the correct implementation of which is a necessary condition for the confident presentation of evidence in court. To assess the quality of an investigation, we can also use an appropriately designed model, which is based on the mathematical principles of multicriteria decision making and is presented in this article.

THEORY

Digital forensic

The Digital forensics is a process that consists of several segments:

1. Identification process (it is necessary to identify the security incident, its scope, possible media and locations of evidence in electronic form).
2. Preservation process (original media, if possible, or possible evidence in electronic form must be protected in an appropriate manner; in the case of protection of media, it is necessary to later obtain and protect any evidence in electronic form in an appropriate manner).
3. Analysis process (appropriately protected electronic data must be analyzed and reviewed and all relevant evidence in electronic form must be excluded).
4. Presentation process (the results of the forensic investigation must be presented in an appropriate manner - written, oral).

Digital forensics thus can be defined as the process of identifying, preserving, analyzing and presenting evidence in electronic form in a manner that is legally acceptable (McKemish, 1999).

Electronic evidence

One of the goals of digital forensics is to obtain electronic evidence about a disputed event. They are used to prove or disprove certain claims and hypotheses, or the act itself. From a legal perspective, electronic evidence is most often defined as the product of an analog device or data in digital form, which is created, modified, stored or connected to any device, computer or computer system or which is transmitted via a communication system and is relevant to the adjudication process.

Electronic evidence is therefore a general term for digital and analog evidence, and is often used as a synonym for digital evidence (Selinšek, 2010).

To be valid in court, evidence must be (Vacca, 2005):

1. Admissible (the evidence must be useful in court or otherwise).
2. Authentic (the evidence must be positively related to the incident, it must be possible to show that the evidence relates to the event under investigation).
3. Complete (it is not enough to collect evidence that shows just one perspective of the incident; in addition to the evidence that can prove the act of the suspect, also evidence that could prove his innocence - exculpatory evidence - must be collected).
4. Reliable (the procedures for collecting and analyzing evidence must not raise doubts about the credibility and credibility of the evidence).
5. Beliveable (the evidence presented must be clear, understandable and credible).

Principles of Digital Forensics

The principles of digital forensics provide the investigator with a framework for work that he must adhere to and must not act differently than the principles dictate, otherwise the collected evidence may be useless or the integrity of the procedure may be compromised. The most important principles are (Šavnik, 2010, 2012):

1. The principle of traceability (all activities related to forensic procedures must be accurately documented, stored and accessible for review in such a way that they can be repeated by an independent third party and achieve the same result).
2. The principle of integrity (no procedure may alter the original copy of the data. If the investigator intends to conduct a forensic investigation of the data, he must make a copy of the original).
3. The principle of professionalism (the investigator must not exceed the level of his knowledge, as he may make incorrect conclusions or even change, damage or partially or completely destroy digital evidence).
4. The principle of chain of custody (digital evidence must be properly protected, therefore the individual is responsible for all activities related to it while in possession of it).
5. The principle of legality (all procedures must be legal, therefore general forensic principles and legal provisions for securing and investigating data must be taken into account).

Privacy and digital forensics

It is important to be aware that the use of digital forensics often also means an interference with the constitutionally protected right to privacy. According to Slovenian law, any interference (investigation) with electronic data carriers is permitted only on the basis of the prior written consent of the owner of the electronic device, who has a reasonable expectation of privacy (the user), or a written court order. An individual's right to privacy is also protected by the criminalization of unjustified interference in the Criminal Code of the Republic of Slovenia and some other laws. Any unjustified interference with an individual's privacy may result in:

- exclusion of unjustly obtained digital evidence,
- disciplinary liability,
- administrative liability,
- liability for damages,
- criminal or minor offence liability.

Forensic investigator

A digital forensics expert is a professional who specializes in collecting, analyzing, and interpreting digital evidence in cases of cyberattacks, computer crime, and other digital incidents. To be successful, a digital forensics expert must possess a number of key qualities. These include a high level of technical skills and knowledge of information security, the ability to understand complex computer systems and how they work, the ability to reason logically, accuracy in data analysis, persistence in solving complex cases, excellent communication skills for reporting the results of their work, and ethics and integrity in handling sensitive information. In addition, a digital forensics expert must keep up with the latest trends and technologies in the field of digital forensics and be prepared for rapid changes and challenges in the digital environment. The ability to work in a team, adapt quickly to new situations, and work under pressure are also key to successfully performing the work of a digital forensics expert. Of course, he must also be well versed in the legal aspects and forensic principles of conducting investigations.

Decision theory

Decision making is usually defined as choosing one of several variants, alternatives, options or versions. The decision maker chooses the version that best meets the given goals. In a broader sense, decision making is a process consisting of several steps or activities and is part of general problem solving. The fields that deal with decision making problems are divided into decision systems, which mainly deal with decision making of artificial systems (computers) and decision sciences, which cover the field of human decision making. They use three approaches: normative, descriptive and decision support approaches. The most important fields that deal with decision making support are operations research, decision analysis, decision support systems and data analysis systems in data warehouses (Bohanec, 2012).

Multicriteria decision making

In a real situation, alternatives have several properties, based on which we decide which one to choose. This type of decision making is called multiparameter or multicriteria decision making. Multicriteria decision making is based on the decomposition of the decision problem into smaller subproblems. Variants are decomposed into individual parameters (criteria, attributes) and they are evaluated separately with respect to each parameter. The final evaluation of the variant is obtained by the aggregation process. The value thus derived is then the basis for selecting the most appropriate variant (Jereb et al., 2003).

Mathematical background

The process that leads to a rational decision is called decision analysis and consists of several steps. In the first, the decision making problem must be defined as clearly as possible. This means that the first question to be answered is what the decision maker is deciding on. Then, the goals that the decision maker wants to achieve must be identified. The fundamental goals are the basis for assessing the consequences of decisions. In the third step, all factors related to the problem under consideration must be identified. Among the factors on which the decision maker has a direct influence, we define the various options from which the decision maker can choose. These are alternatives or choices. In the fourth step, we define a model. This must explain how a decision for a particular alternative leads to a certain consequence in which the set goals are achieved to a greater or lesser extent. In the fifth step, we must define what the final outcomes or consequences of the decision making problem are and assess the desirability of the consequences. The normative decision making theory discusses how a rational decision maker should assess the desirability of consequences over the set goals, and which of the alternatives to choose, after having defined his decision making model. In this theory, we assume that the decision maker can express his desires or preferences using a relation called a strict preference relation (Omladič, 2002).

When making a decision, the decision maker gives some alternatives priority or preference over others. In decision making theory, preference is expressed with preference relations. There are three preference relations (Bohanec, 2012):

- A strict preference relation between alternatives a and b is valid when we prefer alternative a to b ($a \succ b$).
- An indifference relation means that both alternatives are completely equivalent, or that we do not distinguish between the alternatives ($a \sim b$).
- A weak preference relation between alternatives a and b is valid when we like alternative a at least as much as b ($a \succeq b$).

In the context of decision theory, the following properties apply to preference relations:

- A strict preference relation is asymmetric (if $a \succ b$, then $b \succ a$ does not hold) and transitive (if $a \succ b$ and $b \succ c$, then $a \succ c$ also holds).

- An indifference relation is reflexive ($a \sim a$), symmetric (if $a \sim b$, then $b \sim a$ also holds) and transitive (if $a \sim b$ and $b \sim c$, then $a \sim c$ also holds).
- A weak preference relation is strictly dependent (for each pair of alternatives a and b , at least one of the options is true: $a \succeq b$ or $b \succeq a$) and transitive (if $a \succeq b$ and $b \succeq c$, then $a \succeq c$ is also true).

The following relations hold between preference relations:

- Alternatives a and b are equivalent ($a \sim b$) exactly when neither $a \succ b$ nor $b \succ a$ holds between them.
- For alternatives a and b , exactly one of the options is always true: $a \sim b$, $a \succ b$ or $b \succ a$.
- $a \succeq b$ holds exactly when either $a \succ b$ or $a \sim b$ holds.

METHODOLOGY

Mathematical modeling

When we think about a problem, we imagine the situation with a model. Mathematical models have a special place among models. These are abstract, simplified, mathematical constructions that we create for a specific purpose and that to a certain extent reflect reality. We create mathematical models because it forces us to formulate our ideas precisely, but also because mathematics has developed theories that can help us in our thinking. Mathematical thinking helps us primarily in reasoning, that is, in thinking about what conclusions certain assumptions can lead us to. However, the user of the model is responsible for whether he has used the appropriate model in a given situation (Omladič, 2002).

DEX method

DEX is a qualitative (symbolic) method of multiparameter modeling that uses symbolic (qualitative, discrete) parameters (attributes, criteria) and uses discrete utility functions to combine parameter values, which are defined point-wise with tables or what-if rules. Measurement scales are usually arranged from the worst to the best values (Bohanec, 2012).

The decision making process is a process of systematically collecting and organizing knowledge. It should provide enough information for an appropriate decision, reduce the possibility of overlooking something, speed up and reduce the cost of the decision making process, and increase the quality of the decision. The process proceeds through the following phases (Jereb et al., 2003):

- Problem identification (problem definition, definition of goals and requirements).

- Criteria identification (criteria list, criteria structuring, range/interval of values).
- Definition of utility functions (definition of functions that define the influence of lower-level criteria on those that lie higher in the tree, all the way to the root of the tree, which represents the final evaluation of the variants).
- Description of variants (each variant is described by the values of the basic criteria, i.e. those that lie on the leaves of the tree).
- Evaluation and analysis of variants (determining the final evaluation of the variants based on their description according to the basic criteria).

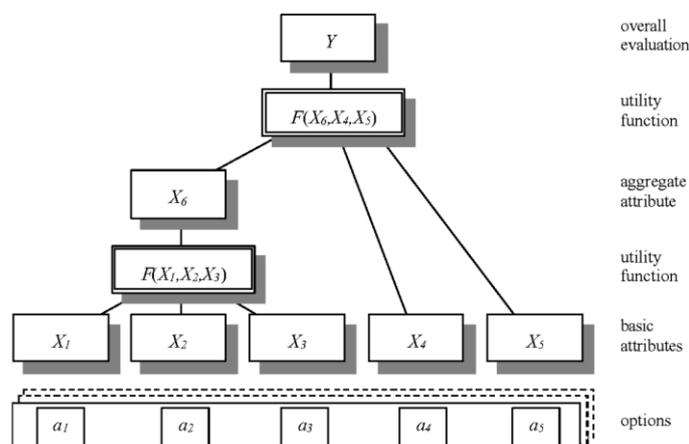
DEXi

DEXi is a software for multicriteria decision making. It is very useful tool for qualitative decision models not just because of validation and verification of the results but also because of making the decision transparent i.e. the understanding why one took some decision.

A multicriteria decision making model represents a decomposition of a decision problem into smaller and less complex subproblems. As shown on Figure 1, model consists of attributes (parameters) and utility functions. Attributes are variables that correspond to decision subproblems and are organized hierarchically. Attributes that occur on higher levels of the hierarchy depend on lower level ones. According to their position in the hierarchy, the attributes are either basic (leaves on terminal nodes) or aggregate (internal nodes, including the root of the hierarchy).

Utility functions define the relationship between the attributes at different levels in the tree. For each aggregate attribute, the corresponding utility function defines a mapping from its immediate descendants in the hierarchy to that attribute. Thus, utility functions serve for aggregation of partial subproblems into overall evaluation or classification of options (Bohanec, 2003).

Figure 1: Multicriteria decision making model (Bohanec, 2003)



DEXi MODEL FOR CONSISTENCY ASSESSMENT OF DIGITAL FORENSIC INVESTIGATION

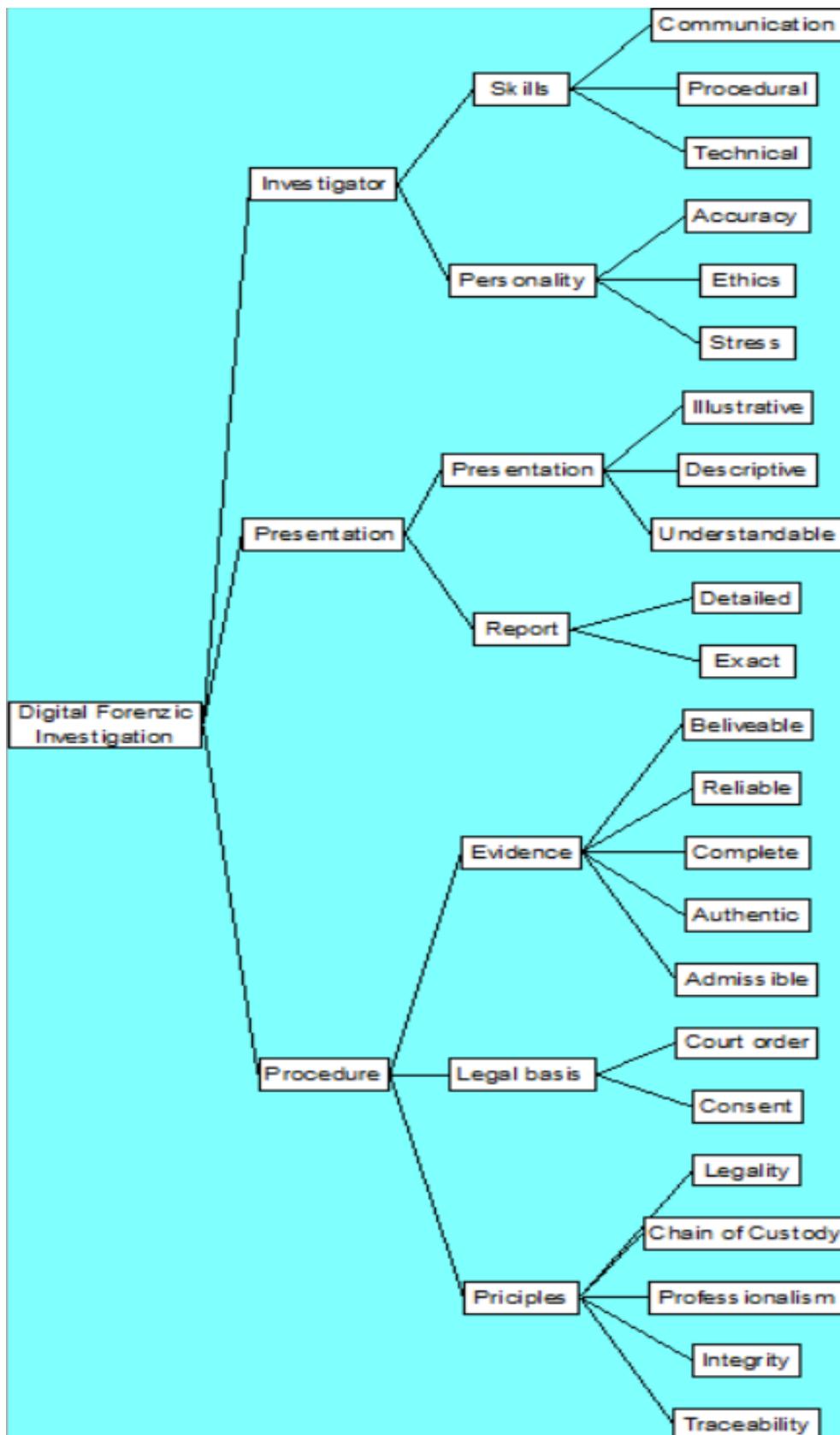
The model was developed with DEXiWin V1.2 software. DEXiWIN is a desktop program for Microsoft Windows aimed at developing and using hierarchical qualitative multicriteria decision models according to the method DEX. DEXiWin is backward compatible with DEXi. It implements all DEXi's features, except loading and saving DEXi models in obsolete data formats (.dax and pre-2000 .xml). DEXiWin can read and process .dxi files produced by DEXi. Also, unless new DEXiWin features are used, .dxi files remain readable by DEXi. DEXiWin is free software: it can be redistributed and/or modified under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or any later version.

The Criteria Tree of developed model was presented via DEXiTree software. DEXiTree is a companion program to DEXi, aimed at making drawings of DEXi's trees of attributes. DEXiTree is implemented in Delphi and is available for Microsoft Windows. The latest version is 0.94 and is compatible with DEXi 4.01 and later.

Problem identification

In the assessment model each investigation was defined as a primary problem which is then divided on to subproblems and described with parameters (criteria). The following goals were set when constructing the criteria tree: the model must take into account the fundamental principles of digital forensics, the necessary characteristics of evidence for validity in court, the adequacy of the investigation procedures, and the competence of the investigators. The quality of the report on the results of the investigation is also important. *Figure 2* shows the criteria tree in DEXi model.

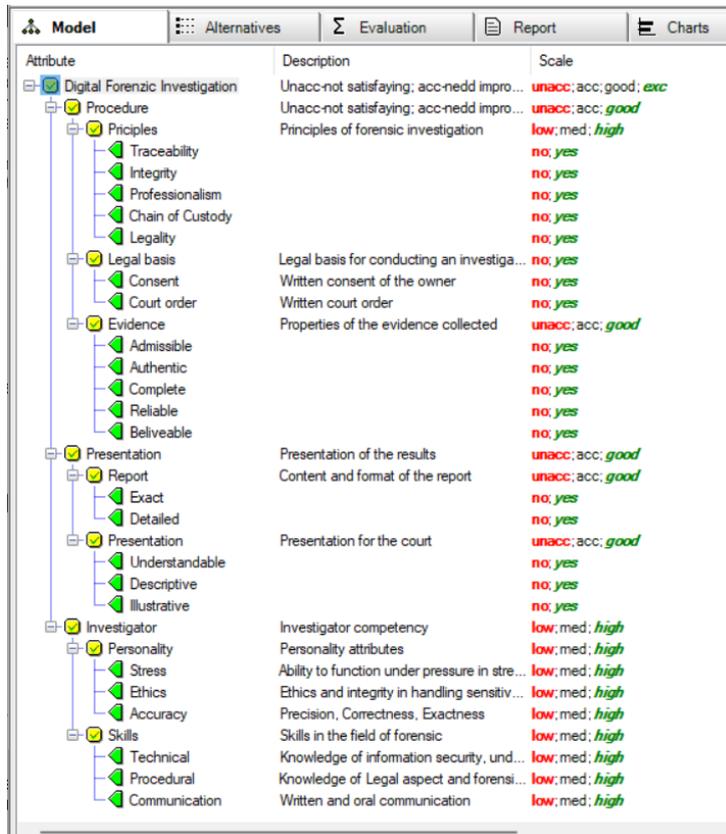
Figure 2: DEXi Criteria Tree



Identified criteria and range of values

Structured criteria for the model with description and the range of values for each criterion are shown in Figure 3.

Figure 3: The range of values of structured criteria



Attribute	Description	Scale
Digital Forensic Investigation	Unacc-not satisfying; acc-nedd impro...	unacc; acc; good; exc
Procedure	Unacc-not satisfying; acc-nedd impro...	unacc; acc; good
Principles	Principles of forensic investigation	low; med; high
Traceability		no; yes
Integrity		no; yes
Professionalism		no; yes
Chain of Custody		no; yes
Legality		no; yes
Legal basis	Legal basis for conducting an investiga...	no; yes
Consent	Written consent of the owner	no; yes
Court order	Written court order	no; yes
Evidence	Properties of the evidence collected	unacc; acc; good
Admissible		no; yes
Authentic		no; yes
Complete		no; yes
Reliable		no; yes
Beliveable		no; yes
Presentation	Presentation of the results	unacc; acc; good
Report	Content and format of the report	unacc; acc; good
Exact		no; yes
Detailed		no; yes
Presentation	Presentation for the court	unacc; acc; good
Understandable		no; yes
Descriptive		no; yes
Illustrative		no; yes
Investigator	Investigator competency	low; med; high
Personality	Personality attributes	low; med; high
Stress	Ability to function under pressure in stre...	low; med; high
Ethics	Ethics and integrity in handling sensitiv...	low; med; high
Accuracy	Precision, Correctness, Exactness	low; med; high
Skills	Skills in the field of forensic	low; med; high
Technical	Knowledge of information security, und...	low; med; high
Procedural	Knowledge of Legal aspect and forensi...	low; med; high
Communication	Written and oral communication	low; med; high

Definition of utility functions

In the next step utility functions for parameters on the same level were defined. Utility functions define the influence of lower-level criteria on those that lie higher in the tree, all the way to the root of the tree, which represents the final evaluation of the variant. Figure 4 shows the utility function for root parameter Digital Forensic Investigation.

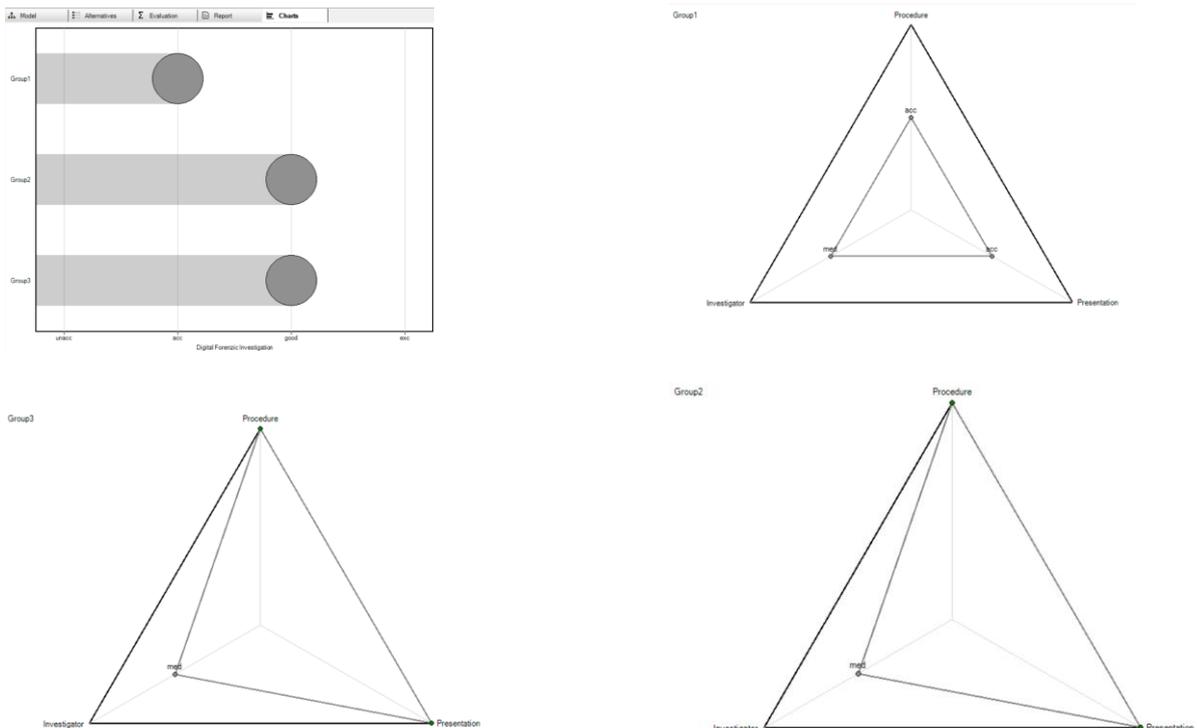
Figure 4: Utility function for root parameter Digital Forensic Investigation.

Stat	Proced...	Present...	Investigator	Digital Forensic Investigation
1 ✓	unacc	unacc	low	unacc
2 ✓	unacc	unacc	med	unacc
3 ✓	unacc	unacc	high	unacc
4 ✓	unacc	acc	low	unacc
5 ✓	unacc	acc	med	unacc
6 ✓	unacc	acc	high	unacc
7 ✓	unacc	good	low	unacc
8 ✓	unacc	good	med	unacc
9 ✓	unacc	good	high	unacc
10 ✓	acc	unacc	low	unacc
11 ✓	acc	unacc	med	unacc
12 ✓	acc	unacc	high	unacc
13 ✓	acc	acc	low	acc
14 ✓	acc	acc	med	acc
15 ✓	acc	acc	high	good
16 ✓	acc	good	low	good
17 ✓	acc	good	med	good
18 ✓	acc	good	high	good
19 ✓	good	unacc	low	unacc
20 ✓	good	unacc	med	unacc
21 ✓	good	unacc	high	unacc
22 ✓	good	acc	low	acc
23 ✓	good	acc	med	good
24 ✓	good	acc	high	good
25 ✓	good	good	low	good
26 ✓	good	good	med	good
27 ✓	good	good	high	exc

TESTING THE MODEL

The model was tested on an investigation conducted by three groups of students in a Computer Forensics course. The model results clearly demonstrated the difference in the quality of the individual investigation steps for each group (Figure 5).

Figure 5: The results of testing



DISCUSSION

From the perspective of practical applications, there are some important properties of models and capabilities of supporting computer tools that are particularly important for the development of a transparent, understandable, and also adaptable and extensible model. The methodology and tools for model development should enable a structured representation of knowledge about the problem area, the possibility of using qualitative models defined by symbolic variables and decision rules, model analysis and the influence of individual factors on the final assessment.

The digital forensics assessment model developed with the DEXi software, presented in this article, represents the use of qualitative hierarchical modeling and its application to a specific forensic process. Although the model is qualitative, and therefore the assessment and results are subjective, it still allows for the identification of those parts of the investigation that need to be addressed in order to raise a particular investigation to a higher level of quality.

The model developed with DEXi provides results that are transparent and understandable to the user-evaluator. The results are displayed using graphs and are thus easily interpretable. The details of an individual part of a specific investigation are easily seen for further analysis of the particular case. The model is also suitable for what-if analysis, as the values of various model parameters can easily be changed and the results of the changes clearly visible. The developed model and its structure can be easily adapted for other types of investigations or similar procedures.

The article presents a basic model, which is nevertheless suitable for a rough assessment of the investigations carried out, and is also useful for educational purposes and as a checklist for the successful conduct of an investigation.

CONCLUSION

In the context of cybercrime research and the use of the DEXi model to assess digital forensics, decision theory plays a key role in understanding and improving decision making processes in the digital environment. Cybercrime is a complex and constantly changing phenomenon that requires rapid and effective action by forensic experts. The DEXi model, which is used to assess the adequacy of digital forensics, allows for the systematic analysis and comparison of different options and helps in choosing the most optimal strategy for resolving digital incidents. By combining decision theory with the field of digital forensics, experts can better understand the complexity of cybercrime and improve the efficiency and effectiveness of their investigative approaches.

However, we must be aware that even when modeling using software tools and artificial intelligence concepts, the responsibility for the correctness of the model itself and the results obtained with it for a given problem space lies solely with its creator - a human.

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EXPLORING BUSINESS LONGEVITY IN ITALIAN SMES: EARLY FINDINGS

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Abstract

This study examines the key factors influencing the longevity of Italian SMEs, a critical yet underexplored issue in strategic management. Given that SMEs account for a significant portion of the economy but face high failure rates, understanding the determinants of their survival is essential.

A quantitative approach was adopted, analyzing data from 111 Italian SMEs across various industries. The study utilized a structured questionnaire to assess constructs related to finance, innovation, governance, performance, and competencies. To evaluate the proposed relationships, Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied using SMART-PLS 4.1, a robust technique suited for small sample sizes and complex models.

The results do not confirm any direct relationships at $p < 0.05$, suggesting that SME longevity is shaped by multifaceted and interdependent factors. However, finance shows potential relevance at $p < 0.1$, while innovation and performance indicate influence at $p < 0.2$. These findings highlight the limitations of traditional static models like RBV and underscore the relevance of Dynamic Capabilities Theory (DCT) in explaining SME survival. Future research should refine methodological approaches, expand the sample, and incorporate longitudinal analysis to track long-term trends.

Key Words

Longevity, SMEs, dynamic capabilities theory.

1. INTRODUCTION

Modern Business longevity is a crucial topic in strategic management, particularly for Small and Medium Enterprises (SMEs), which account for over 99% of businesses in Italy (ISTAT, 2021). While large corporations often have access to extensive resources, SMEs face unique challenges that impact their survival rates. It is widely observed that most SMEs struggle to surpass the first generation, and only about one-third manage to transition successfully to the second generation (Ward, 2016). This challenge is further compounded by the absence of a comprehensive framework for transgenerational success, making the process highly unpredictable and difficult to

navigate (Miller & Le Breton-Miller, 2005). Understanding the determinants of SME longevity is essential for policymakers, entrepreneurs, and business scholars. This study aims to explore the internal and external factors influencing SME longevity in the Italian context.

The notion of "creative destruction" introduced by Joseph Schumpeter (1942) suggests that firms must continuously innovate to survive in competitive markets. Schumpeter's theory underpins the importance of dynamic capabilities and adaptive strategies, particularly for SMEs, which lack the resource buffers of large corporations. His work remains a foundational perspective in studies of business longevity and firm survival (Christensen, 1997).

Understanding longevity in firms is just as important as understanding longevity in humans. In both cases, survival depends on continuous adaptation, learning, and resilience. Just as individuals must maintain physical and cognitive well-being to extend their lifespan, firms must continuously evolve their strategies, capabilities, and business models to remain competitive in dynamic environments (Teece et al., 1997).

This paper is structured as follows. Section 2 presents the theoretical background on firm longevity, reviewing key theories such as Schumpeterian Innovation Theory, Governance Structures, Absorptive Capacity, Financial Stability, and Market Adaptability. Special emphasis is placed on comparing the Resource-Based View (RBV) and Dynamic Capabilities Theory to determine which framework better explains long-term business survival. Section 3 outlines the research methodology, detailing the data sources, analytical approach, and criteria used to assess SME longevity in the Italian context. Section 4 presents the findings and discussion, highlighting empirical evidence that supports the importance of adaptability, governance, and financial stability for SME longevity. Section 5 concludes the study by summarizing key insights, discussing implications for policymakers and business practitioners, and suggesting directions for future research.

2. THEORETICAL BACKGROUND

Firm longevity has been a central issue in strategic management, entrepreneurship, and corporate governance for decades (Hannan & Freeman, 1984; De Geus, 1997; Teece, Pisano, & Shuen, 1997). Despite extensive research, no universally accepted formula guarantees business survival across industries and economic conditions (DeTienne & Chirico, 2013; Miller & Le Breton-Miller, 2005; Lumpkin & Brigham, 2011). Longevity in business remains a "one-million-dollar question," an elusive challenge that scholars and practitioners alike have attempted to decode. While some firms manage to continuously reinvent themselves, adapting to shifting markets and evolving customer needs, others struggle to remain relevant and ultimately fail. This phenomenon is particularly concerning for small and medium-sized enterprises (SMEs), which often lack the financial and strategic resources of large corporations and face higher failure rates (Astrachan, 2010; Ward, 2016; ISTAT, 2021).

Understanding the longevity of firms, particularly small and medium-sized enterprises (SMEs), is a critical yet unresolved issue in strategic management. Despite their significant contribution to economies worldwide, SMEs often face high failure rates, making their sustained success a "one-million-dollar question."

Business survival rates provide a stark illustration of the difficulty of achieving longevity. According to data from the U.S. Bureau of Labor Statistics (2022), approximately 23.2% of new businesses fail within their first year. By the fifth year, 48.0% of firms have ceased operations, and by the tenth year, 65.3% have closed (LendingTree, 2023). These numbers demonstrate that early-stage businesses face significant challenges in establishing long-term stability.

For family-owned businesses, which constitute a significant portion of SMEs worldwide, the odds of long-term survival are even lower. Research from Cornell University (2023) indicates that only 30% of family businesses transition successfully to the second generation, while 12% survive into the third generation, and a mere 3% make it to the fourth generation and beyond (Cornell SC Johnson College of Business, 2023).

These statistics underscore the inherent difficulties SMEs and family-owned businesses face in achieving long-term survival. The high attrition rates highlight the necessity for a deeper understanding of the factors that influence business longevity. Despite extensive research, a definitive solution to ensure enduring success remains elusive, emphasizing the complexity of this issue.

To address this challenge, various theoretical frameworks have been proposed, each offering unique insights into the determinants of firm longevity. The subsequent sections will delve into these frameworks, including Schumpeterian Innovation Theory, Governance Structures and Succession Planning, Absorptive Capacity Theory, Financial Stability and Risk Management, Dynamic Capabilities Theory, and the Resource-Based View (RBV). By examining these perspectives, we aim to shed light on the multifaceted nature of business longevity and explore potential pathways to achieving sustained success.

2.1 The role of innovation and Schumpeterian Innovation Theory

Joseph Schumpeter's (1942) concept of creative destruction argues that economic progress occurs through cycles of innovation, where new businesses and ideas replace outdated firms that fail to adapt. According to this theory, longevity in business is dependent on continuous innovation and strategic renewal. Firms that resist change and remain static are eventually outcompeted by those that adopt new technologies, business models, and operational efficiencies.

Christensen (1997) found that firms that fail to innovate are highly susceptible to market disruption, as seen in industries where technological advancements rapidly redefine competitive landscapes.

A longitudinal study of European firms by Cefis & Marsili (2005) found that innovative firms have significantly higher survival rates than non-innovative firms.

A study of high-tech SMEs in Germany found that firms investing at least 5% of their revenue in R&D had a 40% higher probability of survival than those that did not (Stam & Wennberg, 2009).

In the U.S. manufacturing sector, Patel & Pavitt (1997) showed that firms that consistently introduced new products and patents were twice as likely to survive past 20 years compared to those that relied on existing product lines.

For SMEs, innovation is often a key survival mechanism as they lack the resource buffers that sustain larger firms during market shifts. Studies have shown that

businesses that engage in continuous product development, process improvements, and business model reinvention have significantly higher survival rates than those relying solely on past success (Tushman & O'Reilly, 1996).

Schumpeter's framework suggests that long-lived firms are those that embrace change rather than fear it, reinforcing the argument that adaptive capabilities are essential for longevity.

2.2 Governance Structures and Succession Planning

Governance structures play a critical role in ensuring long-term stability, particularly for family-owned SMEs. Studies indicate that firms with clear governance mechanisms, strategic decision-making frameworks, and succession planning models are more likely to survive across generations (Miller & Le Breton-Miller, 2005).

Strong governance enhances transparency, accountability, and leadership continuity, reducing the risks associated with managerial inefficiencies and internal conflicts (Dossena & Magno, 2022).

Villalonga & Amit (2006) found that family firms with professionalized governance structures (e.g., independent boards, external CEOs) had higher longevity rates than those managed solely by family members.

One of the biggest challenges facing SMEs is leadership transition, as many family businesses fail due to poor succession planning. Research suggests that only 30% of family businesses survive to the second generation, and less than 15% to the third (Ward, 2016).

Astrachan & Shanker (2003) found that among family-owned SMEs, only 30% survived to the second generation, 12% to the third, and 3% beyond the fourth.

A cross-country study by Bennedsen et al. (2007) found that firms with poor succession planning were 60% more likely to fail within five years of a leadership transition.

Organizations with well-structured leadership succession strategies, such as mentorship programs, external advisory boards, and structured CEO transitions, tend to maintain operational continuity and strategic vision beyond generational shifts. This highlights the importance of long-term governance planning as a pillar of firm longevity.

2.3 Financial Stability and Risk Management

Financial stability is one of the most fundamental factors influencing firm longevity. Financial Distress Theory (Altman, 1968) states that firms with weak financial structures struggle to withstand economic downturns, unexpected costs, and competitive pressures.

Companies that maintain healthy cash flow, debt management, and diversified revenue streams have greater resilience during crises, reducing the risk of bankruptcy (Nicolò & Ricca, 2019).

For SMEs, access to financing and capital management is a critical determinant of survival. Many small businesses fail due to undercapitalization, excessive debt, or poor cash flow management.

Research has shown that firms with robust financial strategies, such as reinvesting profits into innovation, maintaining liquid assets, and leveraging financial risk

mitigation techniques, are significantly more likely to survive in volatile markets (Beck et al., 2005).

Financial longevity is not just about profitability, but about financial resilience, ensuring that firms can operate sustainably across business cycles.

2.4 Market Adaptability and the Role of Dynamic Capabilities

The Dynamic Capabilities Theory (Teece et al., 1997) offers a more comprehensive explanation for firm longevity than static resource-based models. This theory argues that firms must continuously develop three core capabilities: Sensing: The ability to identify and assess new opportunities in the marketplace; Seizing: The ability to mobilize resources to capture these opportunities; Transforming: The ability to continuously reconfigure assets and strategies to maintain competitiveness.

Unlike theories that emphasize fixed competitive advantages, the Dynamic Capabilities framework recognizes that long-term survival depends on a firm's ability to evolve with market conditions. Firms that develop strong learning mechanisms, strategic flexibility, and adaptive decision-making processes tend to outlast competitors that rely on static resources or past success (Eisenhardt & Martin, 2000). Empirical studies have found that firms that consistently reinvest in technology, restructure when necessary, and expand into emerging markets are significantly more likely to survive for extended periods (Winter, 2003).

Winter (2003) analyzed **100-year-old firms** and found that their ability to **continuously redefine their business models** contributed to survival.

Doz & Kosonen (2010) introduced the concept of strategic agility, demonstrating that firms with quick response mechanisms to industry changes exhibited higher longevity rates.

This supports the argument that business longevity is primarily a function of adaptability rather than resource accumulation, making Dynamic Capabilities Theory the most relevant framework for explaining long-term survival.

2.4 Innovation Capacity and Absorptive Capacity Theory

The Absorptive Capacity Theory (Cohen & Levinthal, 1990) suggests that a firm's ability to acquire, assimilate, and apply external knowledge is crucial for long-term success. Businesses that continuously learn, invest in R&D, and adapt to industry trends are more likely to endure market fluctuations and sustain a competitive advantage (Lane et al., 2006).

Absorptive capacity is particularly relevant for SMEs, as their ability to leverage external resources—such as collaborations with universities, industry networks, and knowledge-sharing platforms—can compensate for their limited internal capabilities. Firms that integrate new technological advancements, customer insights, and regulatory knowledge into their operations can evolve more effectively. Studies show that firms with high absorptive capacity tend to introduce new products faster, respond better to market crises, and maintain strategic agility, all of which contribute to longevity (Zahra & George, 2002).

2.6 Human Capital and Leadership

The Resource-Based View (RBV) (Barney, 1991) suggests that firms achieve longevity by possessing unique, valuable, rare, and inimitable (VRIN) resources, particularly human capital (Penrose, 1959). Organizations that cultivate highly skilled leadership, strong corporate culture, and continuous employee development can sustain competitive advantages over time.

However, RBV has been criticized for being too static, as it assumes that a firm's existing resources determine success rather than its ability to adapt, learn, and evolve. In contrast, firms that emphasize leadership development, continuous employee training, and strategic HR policies tend to perform better in dynamic environments (Collis, 1994). Reason why the Dynamic Capabilities Theory provides a more flexible and adaptive framework, demonstrating how firms can survive by continuously reconfiguring their resources and strategies (Teece et al., 1997)

Firms that invest in knowledge transfer, leadership succession, and continuous workforce upskilling are more resilient, reinforcing the idea that adaptive leadership is essential for longevity.

2.7 The Dynamic Capabilities Theory

The previous frameworks have provided a key perspective for understanding and interpreting the phenomenon of business longevity. Among these, while acknowledging the importance of the Resource-Based View (RBV), which emphasizes static resource advantages but does not explain how firms adapt to changing environments (Eisenhardt & Martin, 2000), we believe that the theory that best explains the phenomenon of firm longevity is the Dynamic Capabilities Theory (DCT). The DCT provides a more flexible and adaptive framework, showing how firms survive not just by possessing resources, but by reshaping them in response to market conditions, continuously reconfiguring their resources and strategies (Teece et al., 1997). Empirical research suggests that firms with higher adaptability consistently outperform those relying solely on resource accumulation (Winter, 2003).

This study seeks to explore which internal and external factors contribute most significantly to firm longevity. While existing theories offer valuable insights, no single framework fully captures the multidimensional nature of business survival. This study proposes four key research hypotheses based on existing literature:

Hp1: Firms that continuously invest in innovation exhibit greater longevity than those that do not.

Hp2: Strong attention to customer positively impact long-term business survival.

Hp3: Financially stable firms with prudent risk management strategies have higher survival rates than financially fragile firms.

Hp4: Firms that develop competencies are more likely to endure market disruptions and sustain long-term success.

Hp5: Financial Performance influences business longevity.

3. RESEARCH METHODOLOGY

3.1 Data Collection and sampling technique

This study employs a quantitative approach, analyzing a sample of 100 Italian SMEs from various industries and regions. We carried out our analysis by applying our model to a sample of Italian companies operating in north-eastern Italy, in two provinces (Verona and Vicenza) to obtain a homogeneous sample (De Massis et al., 2013) and to ensure the best contacts with companies and their leading associations (i.e., Confindustria and API, which are the most representative associations of companies for this company size and area). A structured questionnaire was prepared and delivered to SMEs located in the provinces of Verona and Vicenza. The questionnaire aimed to collect data on entrepreneurial and family issues, governance structures, innovation activities, financial stability, and market adaptability. A total of 137 responses were collected; however, after removing duplicates and out-of-target companies, 111 usable responses remained. The macro-sectors considered in the study were Manufacturing, Distribution, and Construction, which accounted for more than 50% of the overall companies active in the two provinces. In selecting SMEs, we used as a threshold the number of employees (which had to be in the range of 10-249 employees). We excluded unlimited liability companies, which are typically very small, because Italian legislation does not require them to disclose financial statements. Insolvent companies, under liquidation, or had no activity (i.e., in exceptional situations that may affect data) were not considered, nor were companies with some special legal forms, such as consortiums or cooperatives. The final sample was 111 SMEs. Respondents had to declare if they agreed to a set of sentences regarding each item of our supposed elements able to influence SMEs longevity, mainly with a seven-level scale (1: fully disagree - 7: fully agree). Each question in our questionnaire was coded and assigned to a specific variable. (items are reported in Appendix A).

At the beginning of the questionnaire, respondents were told about the purpose of the research and received detailed instructions on how to answer. They were also assured about confidentiality and aggregate disclosure of data.

We divided the sample into 3 groups to check for non-response bias and compared the first and last groups. The late respondents (which we assume were proxies of non-respondents) revealed non-statistically significant differences compared to the first group, thus confirming the absence of non-response bias.

To prevent common method bias, because the predictor and variable were obtained from the same source, after having paid attention during the design and collection phases of the survey, we implemented a statistical procedure, Harman's single factor test, as suggested by Podsakoff et al. (2003). Since no single factor accounts for more than 50% of the variance among variables, we concluded that common method bias is not a concern for this study.

3.2 Model Estimation

Recent research on SMEs has increasingly focused on statistical modelling and analysis, incorporating sophisticated quantitative methodologies (Boubker et al., 2021). This shift has helped overcome the initial challenges associated with the

complexity of analytical instruments (Manley et al., 2021). Among these methodologies, one of the most widely used is Partial Least Squares Structural Equation Modelling (PLS-SEM) (Hair Jr. et al., 2019), which enables researchers to simultaneously model, estimate, and test complex theories using small sample data (Basco et al., 2021; Sarstedt et al., 2014). PLS-SEM is particularly valuable because it introduces latent variables, which cannot be directly observed but are inferred through mathematical models based on other measurable variables (Basco et al., 2021; Hair Jr. et al., 2014; Hair, Risher, Sarstedt, & Ringle, 2019). Additionally, PLS-SEM does not require normally distributed data, making it especially suitable for managerial and behavioural research, where normality assumptions are often difficult to meet. Given the existing literature, which highlights the complex and interdependent relationship between MA and financial performance, we believe that structural equation modelling is the most appropriate approach for our study. Consequently, we adopted the PLS-SEM methodology and conducted our analysis using SMART-PLS 4.1.

3.3. Measurement of constructs influencing business longevity

Since the research question of this study was the analysis of the factors influencing business longevity in the context of SMEs, in accordance with our literature review we defined a set of questions as broad as possible related to factors potentially influencing business longevity, such as internal competencies, focus on customer, focus on products, innovation, long-term vision, organizational regeneration. The full list of question is reported in Appendix. The starting point was a set of scales related to each of them found in previous studies which we adapted for this research (Bedford & Speklé, 2018). In particular:

- The focus on customer was measured in terms of attention to customer's needs and high level of service (Qe1-Qe2).
- Competencies were accounted measuring the presence of qualified workers (Qc3)
- Finance was measured evaluating both the availability of capital when needed (Qh2) and the reinvestment of profits into the company (Qh3).
- Long-term vision was measured by stability of corporate values and culture (Qa1) and by Long term business vision (Qa2);
- Organizational regeneration was measured by Entrepreneurial and organizational regeneration (Qb1)
- Innovation was rated by Investments in Research & Development (Qd3)
- Performance was evaluated by business profitability (Qb2)

Longevity was measured by the number of years from born.

4. FINDINGS

4.1 Results

Descriptive statistics, including minimum, maximum, mean and standard deviation for the replies from SMEs included in our sample are available upon reasonable

request. Similarly, the correlation matrix (Pearson) of the variables considered in our study is available on request. The correlations between our variables were mostly under 0.5 and only in a few cases were close to 0.70.

4.2. Measurement model assessment

In our model, we assume that all latent variables are antecedents of their indicators and, therefore, our constructs are reflective, reason why we use the calculation procedure based on the consistent PLS-SEM algorithm. For the initial assessment of the model, we examined construct reliability, indicator reliability, convergent validity, and discriminant validity. Detailed results are available upon request.

As a first step, we checked for collinearity by inspecting the variance inflation factors (VIF) values that remained under 3 for all variables (the max value was 2.479).

The reliability of the constructs has been evaluated using Chronbach's alpha, composite reliability rho_a, and composite reliability rho_c. All values were greater than 0.7, ranging from 0.745 to 0.872 for Cronbach's alpha, from 0.751 to 0.878 for composite reliability Rho_a, and from 0.747 to 0.874 for composite reliability Rho_c, thus confirming construct reliability.

Regarding indicator reliability, all factor loadings exceed the 0.728 value, overpassing or being very close to the suggested threshold of 0.7.

Convergent validity was evaluated using Average Variance Extracted (AVE), which should have been greater than 0.5. All constructs obtained values between 0.597 and 0.776, confirming the validity of the proposed reflective scales' internal consistency.

To check the discriminant validity, we inspected the heterotrait-monotrait (HTMT) ratios of the correlations and their 95% one-sided bootstrap confidence intervals. Almost HTMT values were below 0.90 (the maximum value was 0.660). In addition, we also used the Fornell-Larcker criterion to support discriminant validity, checking that the correlation between each pair of constructs did not exceed the square root of the AVE of each of the constructs. For this reason, discriminant validity can be confirmed. As a last step, we evaluated the global quality of the model using the standardized root mean square of residuals (SRMR), which was 0.050 for the saturated model and 0.086 for the estimated model, therefore an acceptable fit considering the recommended threshold of 0.10.

4.3. Structural model assessment and path analysis

As a first step, we checked for collinearity in the structural model, inspecting variance inflation factors (VIF) values for all variables and constructs. None of them exceeded the threshold of 5 also being lower to the more conservative threshold of 3 (values ranged from 1 to 2.348) (Samueli et al. 2019); therefore, we conclude that collinearity is not at critical levels.

Second, we assessed the significance and relevance of the structural model analyzing direct effects and path coefficients. The structural model is presented in Figure 1. A bootstrapping procedure with 15,000 resamples was then used to calculate p-values and f-squared effects. We run bootstrapping using one-tailed p-values at 5%, as we assumed in our hypotheses that coefficients had a positive or negative sign (Kock, 2015). The results with path coefficients and p values are available upon request.

The findings do NOT confirm ($p < 0.05$) that LONGEVITY is influenced by FINANCE, nor by INNOVATION, PERFORMANCE or COMPETENCIES. Therefore Hp1, Hp2, Hp3, and Hp4 are rejected.

Conversely according to our results PERFORMANCE construct influences FINANCE construct ($p < 0.001$), whereas we have no confirmation of the other relationship among constructs.

5. DISCUSSION

The analysis of the results obtained from the selected sample does not allow us to confirm any of our hypotheses, as none of them recorded p-values below 0.05, indicating a lack of statistical significance. Nevertheless, if we consider their potential influence using more lenient reliability thresholds, a positive effect of finance can be observed ($p < 0.1$), while for the PERFORMANCE or INNOVATION constructs, a further relaxation of the threshold to $p < 0.20$ would be necessary to detect any impact. These findings suggest that the proposed factors may still play a role in firm longevity, but their influence is not strongly supported by the current dataset.

The absence of clear statistical significance in our study may be attributed to several factors. First, the sample was geographically concentrated, potentially limiting the generalizability of the findings. Second, the presence of firms with high variance—given that no minimum age requirement was established for participation—may have introduced noise into the data, affecting the results. Third, the category of respondents or, more simply, the way the questionnaire was designed and administered, may have influenced the responses, affecting the consistency and interpretability of the collected data.

To address these limitations, we aim to further refine our analysis by identifying and assessing the potential impact of outliers that may have skewed the results. Additionally, expanding the sample size to include a broader range of firms, possibly across different geographical areas or industry sectors, could provide a more robust dataset. Future research should also consider extending the data collection period to capture potential long-term patterns that may not be evident in a cross-sectional study.

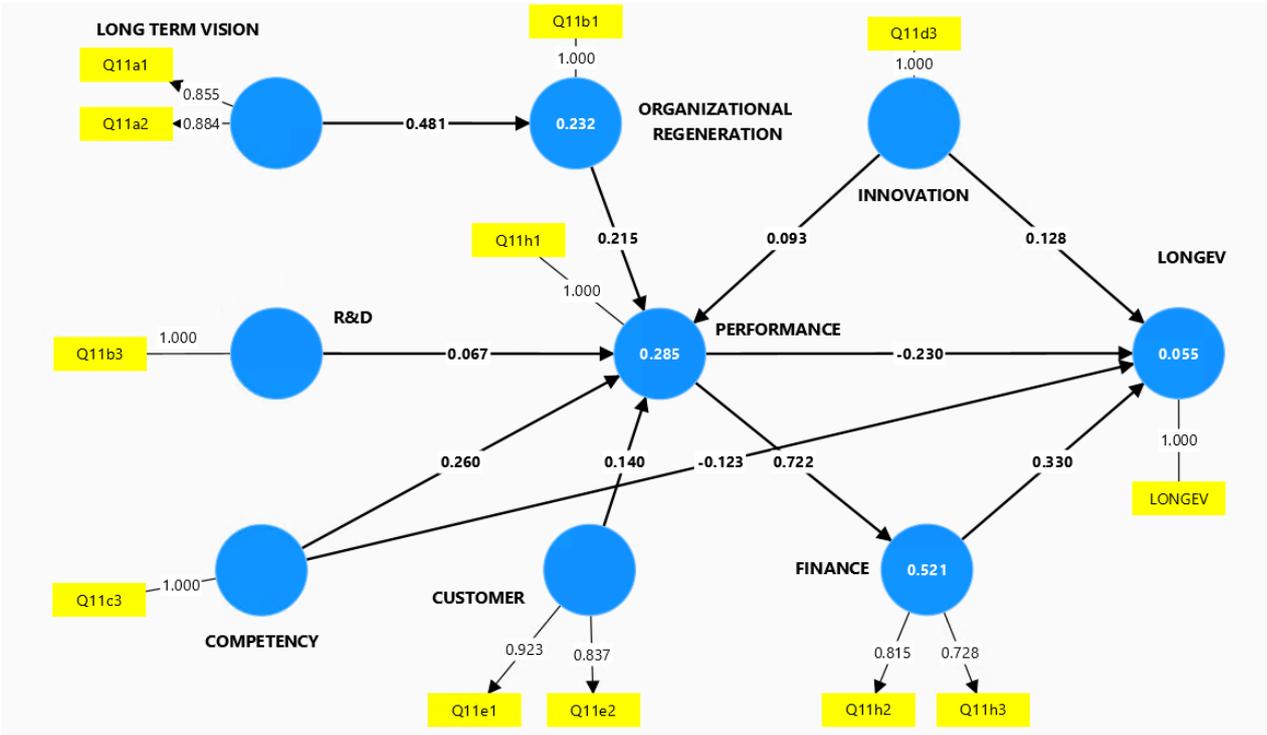
6. CONCLUSIONS AND IMPLICATIONS

This study set out to investigate the factors influencing the longevity of Italian SMEs, a crucial yet complex issue in strategic management. Despite the significant role SMEs play in the economy, their long-term survival remains highly uncertain, with most failing within the first few years and only a small fraction successfully transitioning across generations. Through a quantitative analysis of 111 SMEs, we tested several hypotheses based on financial stability, innovation, performance, and competencies as potential determinants of longevity. However, our findings do not

provide statistical confirmation ($p < 0.05$) for any of the proposed relationships, suggesting that the factors influencing business longevity may be more complex than initially assumed. Nevertheless, when applying more lenient thresholds ($p < 0.1$ and $p < 0.2$), finance emerges as a potentially relevant factor, while innovation and performance might also play a role in shaping firm longevity. These results highlight the intricate and multifaceted nature of business survival, indicating that longevity may not be driven by single, isolated factors but rather by interdependent and context-specific dynamics. The lack of statistically significant findings may be attributed to several limitations, including geographical concentration of the sample, limiting generalizability, high variance among firms, as no minimum age requirement was imposed for participation, potential methodological constraints, such as the design of the questionnaire and the category of respondents, which may have influenced the collected data.

This study has implications for scholars because our findings underscore the need for a more nuanced and integrative approach to studying SME longevity. For business practitioners and policymakers, the study highlights the uncertainty surrounding the drivers of SME longevity, with traditional factors like finance, innovation, and governance that may play an important role but their impact is not universally consistent across all firms. Future research should explore longitudinal models, incorporating other factors such as leadership adaptability or digital transformation, expand the sample size by including SMEs from a broader range of industries and geographical areas, and refine methodological approaches, ensuring that key variables (e.g., firm age, industry sector, ownership structure) are more precisely controlled.

Figure 1: Structural MODEL and Path coefficients



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Appendix A - Questionnaire submitted to companies. List of questions.

(All Responses with Likert scale: 1-7, except LONGEV)

How much do you think the following elements may have influenced the longevity of your company? (Please reply on a scale from 1 to 7. where: 1=not at all; 7=extremely)

(Qa1) Stability of corporate values and culture**

(Qa2) Long-term business vision**

(Qb1) Entrepreneurial and organizational regeneration**

(Qb3) Investments in Research & Development**

(Qc3) Highly qualified workforce

- (Qd3) Continuous product development
- (Qe1) Focus on customer needs
- (Qe2) High level of customer service
- (Qh1) Business profitability
- (Qh2) Availability of capital when needed
- (Qh3) Reinvestment of profits into the company
- (LONGEV) The company longevity in terms of years after birth