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The crowdsourcing data for innovation: Does it matter?

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Purpose – to explore a crowdsourcing data-driven approach to construct crowdknowledge databases for innovation through supporting creative idea generation. In the approach, social media will be used as platforms to crowdsource knowledge for producing the databases.

Findings. Creativity is an essential element of innovation, but producing creative ideas is often challenging in design. Many computational tools have become available recently to support designers in producing creative ideas that are new to individuals. As a standard feature, most of the tools rely on the databases employed, such as ConceptNet and the US Patent Database. This study highlighted that the limitations of these databases have constrained the capabilities of the tools and, thereby, new computational databases supporting the generation of new ideas to a crowd or even history are needed. Crowdsourcing outsources tasks conventionally performed in-house to a crowd and uses external knowledge to solve problems and democratize innovation. Social media is often employed in crowdsourcing for a crowd to create and share knowledge.

Originality/Value. This paper proposes a novel approach employing social media to crowdsource knowledge from a crowd for constructing crowd knowledge databases.

Practical implications. The crowd knowledge database is expected to be used by the current computational tools to support designers producing highly creative ideas that are new to the crowd, in new product design, and ultimately to innovation.

Research limitations/Future research. In this study to provide insights and potential directions for future research are discussed that challenges of employing described approach.

Paper type – theoretical.

Keywords: creativity; project management; data-driven design; innovation; social media; IT-management.

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Дані краудсорсингу для інновацій: чи це має значення?

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Мета роботи – вивчити краудсорсинговий підхід, заснований на даних для створення баз даних краудсорсингу для інновацій за допомогою підтримки генерації творчих ідей. У цьому підході соціальні медіа будуть використовуватися як платформи для краудсорсингу знань для створення баз даних.

Результати дослідження. Творчість – важливий елемент інновацій, проте створення креативних ідей часто складне завдання у проектуванні. Наголошено, що нещодавно багато обчислювальних інструментів стали доступними для підтримки дизайнерів у виробленні нових творчих ідей для окремих замовників. Зазвичай більшість дизайнерських інструментів покладаються на використовувані бази даних, такі як ConceptNet та База даних патентів США. У цьому дослідженні підкреслено, що обмеження цих баз даних зменшують можливості інструментів, а отже, необхідні нові обчислювальні бази даних, що підтримують генерування нових ідей для краудсорсингу або навіть історії процесів. Під час краудсорсингу передають на аутсорсинг завдання, які зазвичай виконують власноруч, з метою використати зовнішні знання для вирішення проблем та демократизації інновацій. Наголошено, що соціальні медіа застосовують у краудсорсингу для накопичення та зовнішнього обміну знаннями.

Оригінальність/Цінність/Наукова новизна дослідження. Запропоновано новий підхід із використання соціальних медіа задля накопичення крауд-баз даних для інновацій.

Практичне значення дослідження. Очікується, що крауд-база даних знань може застосовуватися сучасними обчислювальними інструментами для підтримки дизайнерів, що виробляють висококреативні ідеї, які є новими для краудсорсингу, під час розробці нових продуктів і, зрештою, для інновацій.

Обмеження досліджень/Перспективи подальших досліджень. У цьому дослідженні обговорено проблеми застосування описаного підходу задля надання розуміння та потенційних напрямків для подальших досліджень.

Тип статті – теоретичний.

Ключові слова: творчість; проектне управління; інформаційне проектування; інновації; соціальні засоби комунікації; IT-менеджмент.

Данные краудсорсинга для инноваций: имеет ли это значение?

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Цель работы – изучить краудсорсинговый подход, основанный на данных для создания крауд-баз данных для инноваций посредством поддержки генерации творческих идей. В этом подходе социальные медиа будут использоваться как платформы для краудсорсинга знаний для создания баз данных.

Результаты исследования. Креативность - важный элемент новаторства, но создание креативных идей часто является сложной задачей в проектировании. Отмечено, что в последнее время стало доступно множество вычислительных инструментов для поддержки проектантов в разработке новых творческих идей для отдельных заказчиков. В качестве стандартной функции большинства инструментов проектанты используют базы данных, такие как ConceptNet и Патентная база данных США. В исследовании показано, что ограничения этих баз данных урезают возможности инструментов и, следовательно, необходимы новые вычислительные базы данных, поддерживающие генерацию новых идей для краудсорсинга или даже для истории процессов. При краудсорсинге на аутсорсинг передаются задачи, обычно выполняемые собственными силами, с целью использовать крауд-знания в решении проблем и демократизации инноваций. Отмечено, что социальные сети часто используют в краудсорсинге для накопления и внешнего обмена знаниями.

Оригинальность/Ценность/Научная новизна исследования. Предложен новый подход использования социальных сетей при краудсорсинге для создания крауд-баз данных.

Практическое значение исследования. Ожидается, что база данных коллективных знаний будет использоваться текущими вычислительными инструментами для поддержки проектантов, создающих очень креативные идеи, которые являются новыми в краудсорсинге, в проектировании новых продуктов и, в конечном итоге, в инновациях.

Ограничения исследований /Перспективы будущих исследований. В этом исследовании обсуждаются проблемы использования описанного подхода для предоставления понимания и потенциальных направлений для будущих исследований.

Тип статьи – теоретический.

Ключевые слова: творчество; проектное управление; информационное проектирование; социальные медиа; IT-менеджмент.

1. Introduction

People in some countries use card payments less often than people in other countries and often prefer cash (*Yohannes, 2015*). The first proposed explanation for using cash instead of card for payment is control over money (*Kalckreuth et al., 2014*). One can assume that people in these countries – such as Japan, Germany and Spain – implicitly associate card payments with less control. In order to examine this assumption we decided to run the Implicit Association Test (IAT) (*Greenwald et al., 1998; Greenwald et al., 2002*), which is a reliable method for uncovering implicit associations between concepts on a deep psychological level.

A recent study by *Dasgupta and colleagues* (*2009*) shows that the implicit association can be influenced by the affective state participants are currently in. Consequently, we wanted to investigate whether the implicit association of cash and card payments with high or low control is altered in the specific affective state. In this manuscript, we try to provide an answer to the **research questions** "Do Germans implicitly associate the type of payment with different degrees of control?" and "Is the association influenced by the experienced affective state?"

We chose to perform our analysis in Germany. With this study, we contribute, first, to literature on human behaviour and IT-driven systems interaction. We investigate how implicit associations might shift human preferences concerning the type of payment. Second, we show that the German participants differ in their associations from other participants of the study. This is an interesting insight for cross-cultural research as well as for research on the use of cash payment. Our study uses an innovative method and opens avenues for researchers who seek to understand the effects of implicit association, prejudices, and perceptual biases on human-technology interaction.

2. Theoretical background

2.1. Relevance of payment processes

Payments are needed for all kinds of economic activity. Hence, companies as well as all other organizations have to implement payment processes. Currently, the payments industry is in a state of huge upheaval triggered by regulatory as well as political initiatives. These include the creation of the Single Euro Payments Area (SEPA), the establishment of instant payments, which is already on the way, the revised Payment Services Directive (PSD2), which became fully effective in 2019 in all EU member states, and the regulation on interchange fees (EU 2015/751). Most of the current projects serve the goal to harmonize the euro payments market in Europe, as well as to encourage more competition and open the market to new entrants.

Payments represent a major source of revenue for financial institutions. In fact, payments are not only a source of revenues, but they are the anchor product for various other services. In addition, payment information is a source of knowledge about data on customers, and an opportunity to generate points of reference into the processes of bank' customers – whether private, business, or institutional. Thus, losing stakes in payment transactions to other players would have disastrous consequences for banks.

Payment processes are provided mainly by banks and credit card organizations. However, the emergence of smartphones has allowed new players, such as large Internet and telecommunication enterprises, entering the market (PayPal, Apple, Facebook, Tencent, Alibaba to name a few). Furthermore, numerous companies from the fintech sphere (start-up companies in the financial services sector relying heavily on IT) have appeared on the payments market. The new players aim to integrate their payment services into the customers' processes, thereby capturing customer data, and tying the customers to the company.

2.2. Cash versus card payments

Why do people in countries such as Japan, Germany and Spain prefer cash over card payments? Often the explanation is control over money (*Kalckreuth et al., 2014*). Indeed, cash as well as debit cards are often seen as a monitoring and budgeting tool, especially in times of crises (*Hernandez et al., 2017*). The scholars argue that a substitution of cash by cards may slow down due to environmental turbulences. Therefore, electronic means of payment seem to be far from achieving the expected benefits of cash with regard to perceived control over own budget.

The appetite for cash seems to remain constant since people see cash not only as a mean of payment but mainly as a mean of value storage (*Bech et al., 2018*). Nevertheless, than type of payment has impact on the way consumers behave (*Runnemark et al., 2015*). For instance, *Falk and colleagues* (*2016*) found that the willingness-to-pay increases if consumers switch from cash to card or mobile payments. "Cash payments, which are more transparent than debit card transactions, make it easier to control spending and this effect is not solely due to cash-on-hand constraints" (*Runnemark et al., 2015, p. 286*). Therefore, it is necessary to understand the depth of the association between means of payment and the degree of control by an individual.

3. Methodology

3.1. Implicit Association Test

In an IAT, the participants are confronted with a series of stimuli which they have to sort. The sorting tasks are changing during the test. The regular IAT runs five trials during which the participants (1) have to sort words or pictures from one category (initial target concept discrimination, e.g., payment type: cash versus card), and (2) from the second category (associated attribute discrimination, e.g., control level: low versus high). Afterwards (3), the participants receive a task to make a combined sorting: if they see a picture with a cash payment or a word associated with high control, they have to sort it to the left; and if they see a picture with a card payment or a word associated with low control, then to the right (initial combined task, congruent condition). In the fourth trial (4), the participants have to perform a simple sorting of pictures associated with card or cash payment but the direction of sorting changes (reversed target concept discrimination, erasing of habits developed in the first trial). Finally (5), the participants have to sort words and pictures associated with cash payment and low control to the left and card payment and high control to the right (reversed combined task, incongruent condition).

In order to know the implicit association, the researcher has to calculate the mean time difference between trial five and trial three. A positive number would indicate that the congruent condition holds, i.e., the participants need less time to associate cash payment with high control and card payment with low control vice versa. A negative number indicates that the incongruent condition holds. Put differently, if a participant needs less time for sorting certain categories, we can assume that s/he implicitly associates these categories.

To conduct the test, our research team had to develop a set of stimuli for each category. If in the event of card or cash payment the pictures obviously belong to the specific category (*Fig. 1*), respective words needed to be found and pretested. We followed the procedure suggested by *Bogodistov and Dost* (*2017*).

1. Introduction

Creativity is connected to innovation via design (Han et al., 2018a), while creativity is often associated with idea generation. Idea generation (ideation) is the process of coming up with ideas during the early phases of design. It has been considered the foundation of innovation (*Sarkar & Chakrabarti, 2011; Cash & Štorga, 2015; Zainurossalamia et al., 2020*), which is also a significant element in business success (*Howard et al., 2011*). Therefore, generating creative ideas is essential for achieving innovation. However, it is always challenging for individuals to produce creative ideas due to limited knowledge, many existing ideas, time pressure, and a lack of creative mind (*Han et al., 2018a*). Knowledge is a significant resource in supporting innovation (*Bertola & Teixeira, 2003*), but it is difficult and time-consuming to collect information and knowledge for assisting idea generation. *Ullman* (*2010*) indicated that design engineers spend 60% of the time during the design process to explore the information and knowledge needed. Therefore, the designers need support in creating and leading to innovation, relevant knowledge, or a database containing the necessary knowledge.

There is an ever-growing interest in applying computational tools for supporting designers in generating creative ideas in recent decades. Databases, containing knowledge for supporting design, are often employed by the tools. Various databases are used, for instance, design repositories, ConceptNet, biological and engineering systems in structure-behaviour-function forms, and customized ones. However, some databases involve a limited amount of knowledge, some are not suitable for design, and some mainly contains prior knowledge. Besides, new knowledge emerges rapidly in nowadays fast developing world. Nowadays, to produce creative ideas for the development the innovative products and up-to-date knowledge is needed. Thereby, it is needed to explore how to employ rapidly emerged knowledge to support designers in creativity and innovation. Crowdsourcing is a model where answering open calls generate many solutions. *Goucher-Lambert and Cagan* (*2019*) have shown the use of crowdsourcing to generate inspirational stimuli to support idea generation. Social media is described as 'a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content' (*Kaplan & Haenlein, 2010*). So, such social media, as Twitter and Facebook, are considered platforms that are often used by crowds for creating knowledge. When taking advantage of crowdsourcing and social media, databases containing up-to-date knowledge created by the crowd could be constructed.

2. Problem statement

This paper aims to explore a crowdsourcing data-driven approach to construct crowd knowledge databases for innovation through supporting creative idea generation. In the approach, social media will be used as platforms to crowdsource knowledge for producing the databases.

3. Methods and data

The crowd knowledge databases strive to be employed in existing computational creativity tools for improving the tools' performances and capabilities. That benefits the generation of creative ideas and leads to innovative products. The following section investigates creativity in design. *Sections 4.1 and 4.2* explore crowdsourcing and related frameworks, respectively. *Section 4.3* proposes a crowdsourcing data-driven approach based on the explorations. *Section 4.4* discusses the challenges involved in this approach, with conclusions in *section 5*.

4. Results

4.1. Design Creativity

Creativity is considered a significant element in the design, defined as producing something judged to be creative (*Amabile, 1983*). *Han et al.* (*2019*) have indicated that novelty, surprise, and usefulness are the three core factors of creativity in design. Idea generation involves the process of creating developing and communicating ideas, where ideas are fundamental elements of thoughts in visual, concrete, and abstract forms (*Jonson, 2005*). Idea generation has been considered essential to innovation (*Sarkar & Chakrabarti, 2011; Cash & Štorga, 2015*). However, idea generation, especially generating creative ideas, is challenging in new product design and development.

Creativity tools and methods are thereby developed and used to support designers in creative idea generation during the early stages of design. There exist two categories of tools for supporting creative idea generation, non-computational and computational tools. Non-computational tools, such as TRIZ (*Altshuller, 1984*), design-by-analogy (*Goldschmidt, 2001*), and the 77 design heuristics (*Yilmaz et al., 2016*), provides designers with guidelines and instructions for producing creative ideas. Nevertheless, some of the tools rely heavily on designers' knowledge, while others are challenging to master.

In recent years, computational tools that involve the use of computational techniques for supporting idea generation have been explored. These tools could produce creative prompts and provide relevant knowledge to support designers in creative idea generation more effectively and efficiently. The Retriever (*Han et al., 2018b*) prompts designers in generating creative ideas by constructing new ontologies to support reasoning by employing real-world data. The database employed in the tool is the ConceptNet (*Speer et al., 2017*), which is a machine-understandable knowledge network. The knowledge contained is mainly practical knowledge, which has limited the Retriever in constructing profoundly new ontologies for supporting idea generation. Analogy Finder (*McCaffrey & Spector, 2017*) provides users with adaptable analogous ideas for solving technical problems by conducting searches using the US patent database. However, the tool requires the users to have substantial expertise and knowledge to adapt the ideas retrieved from the US patent database employed for solving problems. Idea Inspire 4.0 of designers (*Keshwani & Chakrabarti, 2017*) generate creative ideas for solving problems via analogical design. A searchable knowledgebase is employed in the tool containing a limited number of biological systems. An automated approach has been proposed by *Keshwani and Chakrabarti* (*2017*) for populating the database.

Creativity covers two main categories, H-creativity and P-creativity (*Boden, 2004*). H-creativity refers to historical-creativity, which indicates generating ideas that are new in history. P-creativity, also known as psychological-creativity, indicates producing new ideas to the person who produced the idea. When compared with the design creativity studies at P-creativity levels, fewer studies focus on H-creativity levels. Hence, it requires to develop design creativity at H-creativity levels, investigating how to produce new ideas to a group of people, a crowd, and, ultimately, history. From a group perspective, studies such as the ones conducted by *Paulus & Dzindolet* (*2008*) and *Nijstad & Stroebe* (*2006*) have shown that collaboration has positive effects on creativity. *Paulus et al.* (*2012*) have revealed that collaborative creativity could produce better outcomes than individual creativity. That indicates that using groups could produce ideas that are better than the ones produced by individuals. Ideas produced by a group are new to the group, which are beyond P-creativity and close to H-creativity. Employing an even more significant number of people, such as a crowd, could lead to the generation of ideas belonging to the H-creativity category.

As illustrated above, databases play a significant role in nowadays computational tools. However, the databases employed by the tools have various limitations, which have negative impacts on the tools' capabilities. Besides, the use of a crowd in supporting design creativity, especially creative idea generation, could yield superior results. A crowd could be employed to produce ideas or provide knowledge for solving design problems. The ideas produced and knowledge provided by the crowd could be constructed into a crowd knowledge database to support designers in producing creative ideas to solve the design problem. Thus, it requires a new approach to creating crowd knowledge databases for computational tools to support designers in creative idea generation needs.

4.2. Crowdsourcing for Innovation

Crowdsourcing is described as a web-based creative problem-solving model, in which "a distributed network of individuals produces solutions to an open call for proposals" (*Brabham, 2008*). In the context of design, *Forbes & Schaefer* (*2018*) suggest that crowdsourcing is most suited to evaluation and ideation, as shown in *Fig. 1.* Later design phases require a higher skill level and are therefore are harder to "open to the crowd." Therefore, the suitability for ideation and other early design stages is a consequence of the inverse relationship between the qualified crowd size and the level of skill for contribution. For example, in concept generation, "ideas are not scrutinized on their technical rigor or feasibility" (*Daly et al., 2012; Forbes et al., 2019*). The number of those qualified to make these contributions is higher than later design phases, and therefore the crowd available in this phase is large. However, that was founded on the assumption that a more significant number of contributions result in a more successful crowdsourcing initiative. *Panchal* (*2015*) discusses several "modes of failure" for crowdsourcing initiatives, including "a lack of submissions," but also the result of "numerous poor-quality submissions." Therefore, it is essential to consider that while we assume that a higher number of submissions is preferable, submissions can be detrimental to the success of the crowdsourcing initiative. Examples of initiatives that use crowdsourcing for idea generation include *Goucher-Lambert & Cagan* (*2019*), who have used crowdsourcing techniques to "obtain inspirational stimuli" to support designers in ideation. "Connect and Develop" from Procter and Gamble is another example described as an "organization partnership" with "the world's most innovative minds." As part of Connect and Develop, Procter, and Gamble encourage the crowd to submit product ideas and suggestions according to a theme most relevant to their organization (*Dodgson et al., 2006*). Since using crowdsourcing for idea generation, Procter and Gamble's R & D productivity increased by 60%, and 45% of new initiatives had elements discovered externally (*Dodgson et al., 2006; Forbes et al., 2019*). A final example is the DARPA crowdsourcing initiative, which awarded one million dollars to a design team, external to the organization, to create an "innovative marine tank drive train" designed to significantly improve the efficiency of tank movement (*Ackerman, 2013*). According to the *Fig. 1*, the crowdsourcing demonstrated success in many idea generation initiatives (*Forbes et al., 2019*). Including the crowdsourcing process as an element of a data-driven approach for design creativity, whereby formalizing this process, could, therefore, prove useful to designers.

There are two types of crowdsourcing; active crowdsourcing and passive crowdsourcing. Active crowdsourcing is leveraged when the crowd actively participates in a contest or call for submissions. There are four types of active crowdsourcing initiative, crowdsourcing contests, open calls with direct rewards, open calls with direct rewards and micro-tasking. *Table 1* below gives definitions and examples of these crowdsourcing initiatives.

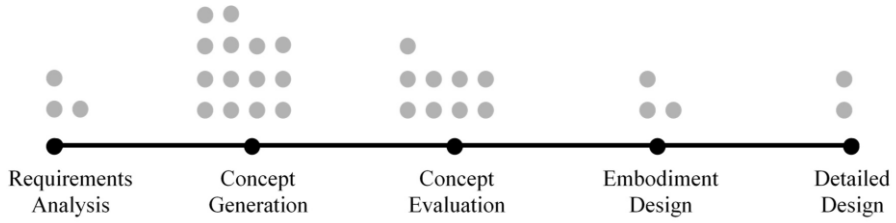

Fig. 1. Current literature's exploration of crowdsourcing in each product development phase*

**Source:* compiled based on (*Forbes & Schaefer (2018)*.

Table 1

Active crowdsourcing initiatives*

Initiative	Example	Description
Crowdsourcing contests	Gold Corp "Global Search Challenge" (*Brabham, 2008*)	Participants from different countries were encouraged to examine geologic data from Goldcorp's Red Lake Mine and submit proposals to identify potential targets with the next 6 million ounces of gold gets found. The $500,000 in prize money was offered to the 25 top finalists who identified the most gold deposits (*Brabham, 2008; Corp, 2001*)
Open calls with direct rewards	Procter & Gamble's Connect & Develop (*Dodgson et al., 2006*)	Procter & Gamble advertise their research and development needs through a crowdsourcing initiative, called Connect & Develop, in classified categories. Anyone interested in or has a solution within the advertised categories could propose their ideas by submitting through the Connect & Develop a website. The ideas get assessed by a specialized team, and reward payments can range from $10,000 to $100,000 (*Dodgson et al., 2006*)
Open calls with indirect benefits	Dell Idea Storm	With a similar setup to Connect & Develop, Dell Idea Storm is looking for ideas on their website from a community of non- experts. Contributors, however, are not rewarded financially and instead benefit indirectly from the company's implementation of the ideas in their products (*Di Gangi & Wasko, 2009*)
Micro-tasks	Amazon Mechanical Turk	Amazon Mechanical Turk is a website allowing businesses to hire participants "to perform discrete on-demand tasks that computers are currently unable to do." (*Buhrmester et al., 2011*)

*Source: compiled based on (*Panchal, 2015*).

On the other hand, passive crowdsourcing uses information from the crowd in the public domain or has been collected with permission from the crowd (*Charalabidis et al., 2014*). The used information depends entirely on the methodology applied by the data collectors, and the data content does not influence it. An example of passive crowdsourcing is Netflix's use of customer choices to supply film and TV recommendations.

Using crowd data to populate computational creativity tools is a hybrid crowdsourcing approach using both active and passive crowdsourcing. An open call with indirect rewards, an active crowdsourcing initiative, is used to encourage the crowd to share their ideas. Followed by a set method to process the data for use in a computational creativity tool, representing a passive crowdsourcing approach. Several other authors have implemented hybrid active and passive crowdsourcing approaches. For example, *Janssen et al.* (*2017*) use a hybrid approach to crowdsourcing for policymaking. They state that "combining both approaches can create the synergy. Passive crowdsourcing results can guide active crowdsourcing to avoid asking users for similar types of input".

Similarly, Charalabidis et al. (*2014*) use a hybrid approach for policymaking by "exploiting the extensive political content was continuously created in numerous Web 2.0 [technologies]". Finally, *Akshay et al.* (*2018*) use passive and active crowdsourcing for monitoring video for critical events stating that this approach "increases the feasibility of deploying continuous real-time crowdsourcing systems in real-world settings." Therefore, there is evidence of using crowdsourcing and an active-passive crowdsourcing approach for innovation in several research fields.

Despite evidence of similar successful uses of crowdsourcing, some crowdsourcing initiatives are more effective than others (*Panchal, 2015*). Ineffective crowdsourcing initiatives may invite incomplete submissions that fail to reach the required quality. A crowdsourcing initiative can also become ineffective if running the initiative exceeds the cost of an in-house team (*Brabham, 2008; Panchal, 2015*). As a result, it requires frame crowdsourcing processes. The following section presents existing crowdsourcing frameworks.

4.3. Crowdsourcing Frameworks

Crowdsourcing has emerged with the birth of the internet and with the ability to share information quickly and easily, worldwide. Social media has been a catalyst in this growth by facilitating and supporting users to create, share, and edit information, as well as build relationships through interaction and collaboration (*Mount & Martinez, 2014*). *Kemp* (*2019*) reported that there are 3.48 billion social media users in 2019, which leads to millions of posts every minute (*Forbes et al., 2019*). When an open call crowdsourcing initiative starts on social media, therefore, potential participants can be reached with quick and easy ideas submission. Preventing crowdsourcing failure, when leveraging social media, requires a methodical approach. Before presenting a new crowdsourcing social media framework for computational creativity, the authors explored existing research.

Crowdsourcing frameworks are most prevalent in the field of product design and development. *Niu et al.* (*2019*) present a framework for crowdsourcing in product development, guiding users through critical crowdsourcing decisions. *Panchal* (*2015*) also presents a framework for crowdsourcing in product development, providing a four-step approach to crowdsourcing application. This framework includes three key steps; selecting crowdsourcing initiatives, making a design decision, and incentive design. Panchal also provides further detail regarding "incentive design" by presenting a game-theoretic model for managing crowd participation. Similarly, *Abrahmason et al.* (*2013*) present an "Incentives Mix Framework" for understanding crowd participation, and *Cullina et al.* (*2016*) and *Gerth et al.* (*2012*) provide in-depth research on finding the "qualified crowd" in crowdsourcing contests. Finally, *Kittur et al.* (*2011*) consider the crowdsourcing of Human Intelligence Tasks (HITs) and "provide a systematic and dynamic way for breaking down tasks into subtasks and manage the flow and dependencies between them."

In other fields, few authors have presented a crowdsourcing framework for their domain. *To & Shahabi* (*2018*) propose a crowdsourcing framework for "protecting worker location privacy in spatial crowdsourcing," *Liu* (*2014*) present a "crisis crowdsourcing framework" for "designing strategic configurations of crowdsourcing for the emergency management domain" and *Chen et al.* (*2009*) present a "QoE evaluation framework for multimedia content." These authors represent the scarcity of crowdsourcing frameworks and demonstrate the relative youth of this research topic. By creating a crowdsourcing framework for creativity, and specifically, computation, creativity is a significant contribution in an emerging literature sector. Furthermore, existing crowdsourcing frameworks are generally at a low level of abstraction, addressing, and guiding small aspects of the crowdsourcing process instead of offering high-level support. For example, *Cullina et al.* (*2016*) discuss the need to understand crowd motivation in contests, which is a single factor contributing to the successful implementation of crowdsourcing. By presenting a high-level crowdsourcing framework for computational creativity, the authors offer more holistic guidance for crowdsourcing applications.

4.4. The Crowdsourcing Data-driven Approach

As illustrated above, crowdsourcing initiatives allow varied and numerous data points to be collected from the crowd. They are particularly useful in early design phases as the prerequisite skill level for participation in these phases. This section demonstrates how crowdsourcing could acquire knowledge from a crowd to support creative design activities in new product design and development, such as idea generation and evaluation, by partnering crowdsourcing with computational creativity tools.

A novel approach using social media to crowdsourcing design knowledge for creating crowd knowledge databases is proposed, as shown in *Fig.* 2. In step 1, an open design challenge call is posted on social media, such as Twitter and Facebook. A dedicated hashtag is involved in the open call post. The hashtag will help the crowd identify the open call on social media and be used as a target to support the later data mining process. In step 2, an effective crowdsourcing method encourages the crowd to generate ideas using descriptive text to solve the design challenge in the open call.

The ideas generated are posted back on social media containing the dedicated hashtag. Data mining is conducted in the next step to retrieve posts containing the dedicated hashtag only. That will help to discard noise data, which are irrelevant to the open call. In step 4, the retrieved data are processed using natural language processing tools to extract useful words and phrases. The extracted data are used to construct crowd knowledge databases for supporting creativity and innovation in step 5. In the last step, the crowd knowledge databases constructed will be used by exiting computational design creativity tools to enhance the capabilities of the tools in supporting idea generation. For example, the Combinator (*Han et al., 2018a*) can employ the databases to produce combinational prompts associating knowledge produced by the crowd.

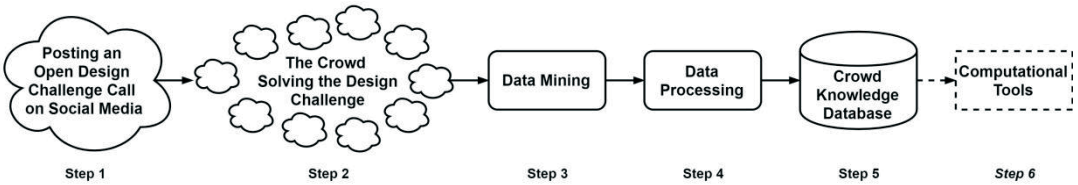

Fig. 2. The crowdsourcing data-driven approach of creating a crowd knowledge database*

*Source: compiled by Authors.

5. Discussion

After having presented the approach, this section considers the hurdles and challenges for implementation. There are three critical phases of the approach that require attention. That includes, firstly, how participation will be encouraged and managed. Secondly, how the submitted responses will be processed is significant in determining the value of ideas generated from this crowd-knowledge database. At last, it is essential to determine how the submitted responses are included as part of the computational creativity tool and whether this should differ from other databases. The third phase, regarding the use of the database, is managed by existing computational creativity tools, but the discussion (*Forbes et al., 2019*) includes the first and second phases.

When considering the management of participation, social media allows access to the most significant number of people possible, making it an effective medium for hosting passive and active crowdsourcing initiatives. The difficulty, however, is gaining active participation in these platforms. "Social media is used extensively and constantly to attract attention, and users can often be overwhelmed with online content" *(Forbes et al., 2019)*. Enticing submissions, therefore, requires strategic thinking. Besides, high numbers are essential, but a wide variety is also crucial for generating innovative ideas (*Howe, 2006*). Organizations use crowdsourcing initiatives because they recognize a need to involve other perspectives beyond those of their in-house teams. Therefore, the effort must be made to increase the hashtag's exposure while limiting the "echo chamber effect" that can reduce the heterogeneity of the responses (*Colleoni et al., 2014; Forbes et al., 2019*). There is a need to manage how the hashtag is exposed to potential crowdsourcing participants to ensure text-based responses from users are useful for generating creative ideas.

Within crowdsourcing and creativity research domains, solutions to this challenge are limited. Therefore, the authors considered other research domains, such as digital marketing, to offer an understanding of how organizations can compete for social media attention while running a crowdsourcing initiative. So that to correspond with the required traits of captured data, the authors were interested in solutions to capture diverse information and solutions to capture numerous data. Regarding managing diversity, existing literature on the impact of social media on political preference offered insight. Ensuring a heterogeneous dataset meant limiting the impact of "social media bubbles" or "echo chambers" (*Zhan et al., 2016; Romero et al., 2011*), which is of significant interest in the current political climate. *Garimella et al.* (*2017*) offer a solution that could apply to crowdsource for computational creativity. They suggest when "exposing information" to users, a "symmetric difference function" could be "optimized" to limit the dominance of one piece of information in the case of two competing instances of information. In the context of ensuring diverse submissions, engaging a "symmetric difference function" could ensure that a single submission on the social platform would not influence subsequent submissions. *Dubois & Blank (2018)* also propose another solution, which suggests the ownness is on the user to limit their vulnerability to polarising online content. They demonstrate that users with "diverse interests" on social media platforms are significantly less susceptible to exposure to polarising content. Therefore, a solution to ensure heterogeneous submissions for a crowdsourcing activity could be target users with connections with a range of interests and political viewpoints.

The authors were also interested in learning how a crowdsourcing initiative could "compete for attention" on social media platforms (*Romero at al., 2011*). *Feng et al.* (*2015*) suggest garnering attention on "busy" social media platforms, information sharers need to understand how and when users become "overload with information" and respond accordingly. They show how information spread on social media can be represented by a fractional susceptible infected recovered (FSIR) model. In this case, bacteria spread is analogous to information spread and infection presents information overload (*Feng et al., 2015*). Using this model, *Feng et al.* (*2015*) suggest spreading information early in the day and early in a "social information cycle," which they describe in detail. *Iyer & Zsolt* (*2015*) suggest that to compete for attention on social media platforms, information sharers must consider the incentives users respond to for social media use in general. They then suggest embedding these incentives, such as the ability to connect with others, into the mechanism they use to spread information (*Iyer & Zsolt, 2015*). Each of these existing solutions can be considered when implementing the crowdsourcing data-driven approach. How the submitted responses will be processed is significant in determining the value of ideas generated from this crowd-knowledge database. Using texts to provoke the designers' mind in producing creative ideas has been demonstrated in several previous studies, but in various forms (*Forbes et al., 2019*). For example, *Shi et al.* (*2017*) employed network-based texts, while *Han et al. (2018a*) used combinational texts. However, the presentation form of crowd knowledge, the solutions generated by the crowd and processed by computational means in this study, still needs to be explored (*Forbes et al., 2019*).

The collection of social media data differs from data (text) used in previous studies. Crowd data may include sentimental as well as emotional aspects. That means that the process of natural language process must include a measurement of sentiment to determine the positivity and negativity of the whole text. Overall, emotionality needs to be calculated on individual text segments to indicate positive and negative text segments. Emotionality could support designers in decision-making by ensuring they have a greater understanding and further context of crowd data. For example, designers might need to avoid the design aspects of negative knowledge and enhance design features related to actual knowledge (*Forbes et al., 2019*). That might also help the computational tools in a better comprehension of the crowd knowledge database employed.

The way social media users communicate has developed beyond just text-based, which should be considered, further, to processing emotional and sentimental aspects of participant responses, "Emojis," "GIFs" and "memes" are frequently and extensively used on social media to communicate ideas. Their use means either they must be filtered and removed, or "translated" for inclusion in a crowd database. One approach to this, as shown in *Fig.* 2, includes using keywords to identify the critical idea communicated in participant responses. However, it could be the case when the critical idea is communicated in a text-based caption with an image accompaniment to bolster, as opposed to conveying, the idea. How this different use of video and image-based content is managed should be taken into consideration.

Twitter and other social media platforms are purposefully designed to encourage collaboration and interaction between users. That results in functionality elaborating and "commenting" on other responses that are considered integral to the design of these online platforms. As a result, however, the processing of participant involvement needs to recognize not only individual responses, including the hashtag but "clusters" or responses that all represent one idea (*Forbes et al., 2019*). For example, one participant may include the "crowdsourcing hashtag" to present an idea that initiates an online conversation, with further responses elaborating on or supporting the initial idea. Some of these comments may be new ideas, but others could be minor alterations or additions to the original submission. That means that including every response involved in the conversation and weighting them could equally disrupt the value of crowd data. An understanding of how collaboration occurs on social media is fundamental to procuring valuable results for idea generation (*Forbes et al., 2019*).

Utilizing crowd knowledge from social media shows great potential for supporting creativity and innovation. However, there are several research challenges, such as participation management and data processing, to overcome. Furthermore, the way social media users communicate has and will change to incorporate more media-based content. Further research is needed to solve these research challenges and recognize new opportunities in the applications of this crowdsourcing data-driven approach. The critical next research step is to conduct a case study using crowd knowledge from a specific social media platform to solve a design challenge. The authors hope to provide more insights into this new and novel data-driven computer-aided innovation approach.

6. Conclusions

Generating ideas, especially creative ones, is significant to innovation. However, it is challenging to produce creative ideas. Many computational support tools are developed to assist this process, but available databases constrain the current solutions. Lacking knowledge in terms of quantity and variety is one of the main issues of the databases. Besides, knowledge collection has been considered a time-consuming and frustrating activity (*Darma et al., 2020*). Crowdsourcing is a model for creative problem-solving which uses the knowledge produced by a distributed network of individuals, also known as a crowd. Social media, which allows creating and exchanging content created by users, is often employed to generate and share knowledge.

Thus, the authors of this paper have proposed a novel data-driven approach utilizing social media to crowdsourcing knowledge to construct databases for computational tools to support creative idea generation, ultimately leading to innovation. The databases constructed are called the crowd knowledge databases populated by providing and distributing open design challenge calls with responses using unique hashtags for identification. Data mining and natural language processing are used in the construction process to retrieve and extract data, respectively. The crowd knowledge databases can then be implemented into existing and future computational tools to enhance their performances. Using the Combinator (*Han et al., 2018a*) as an example, the tool could associate crowd knowledge from the database to produce new combinational prompts, which are new to the crowd, for stimulating users' creative minds. The data-driven approach proposed has implied its value of utilizing some of the most used and data-rich platforms available to achieve innovation.

However, some challenges need to be solved to realize the crowdsourcing data-driven approach. This paper discusses how to manage participation in social media and how to process various types of information. Several participation management methods, such as information spreading and incentives, as well as several information processing issues, such as sentiment measurements and collaboration, understands, are indicated. Further research is required to explore these challenges and to overcome them, to fully employ the proposed crowdsourcing data-driven approach in computational support tools for innovation. This paper has thereby shown a new research direction in using crowdsourcing data to support innovation, contributing to the computer-aided innovation research area. The authors have planned to conduct a case study of solving a design challenge using the crowd knowledge from a specific social media platform, such as Twitter, in their next study to provide more valuable insights.

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8. The competing interests

The authors declare that they have no competing interests.

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A conceptual framework of transformational leadership as an influential tool in the team performance

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Purpose – to identify the relationship between the transformational leadership approach and team performance, to analyze the existing literature that expresses the role of transformational leadership on team performance and to create a guideline for the leaders to increase their performance.

Design/Method/Approach. To achieve the purpose o.f the study 86 articles and books were analyzed in terms of transformational leadership, team performance, and the relationship between these two concepts.

Findings. Leadership is one of the essential words in today's organizational direction. Despite that, transformational leadership has excellent attention on leadership theory. A few numbers of researches are done on analyzing the relationship between transformational leadership and team performance. The findings show that transformational leadership remains the most crucial leadership style in improving team performance.

Originality / Value. The originality of the study is that no one researcher before has analyzed the relationship between transformational leadership and team performance, like this study, which includes analyzing the existing literature over 50 years of research made on this topic by numerous researchers.

Theoretical implications. This study's theoretical significance increases opinion and change of judgment for performance appraisal on the working life quality.

Practical implications. The practical benefit of this study is that it provides a guideline for managers use the leadership style correctly to increase the performance of a team, and as a result their organization.

Research limitattions / Future research. The projections for further research are to analyze the relationship between the transformational leadership approach and team performance, add other dimensions, and measure their common effects on such relationship.

Paper type – theoretical.

Keywords: team performance; leadership style; team cohesion; effectiveness.

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Концептуальна основа трансформаційного лідерства як впливового інструменту в роботі команди

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Мета роботи – виявити взаємозв'язок між трансформаційним лідерським підходом та результатами роботи команди, проаналізувати існуючу літературу, що виражає роль трансформаційного лідерства в роботі команди, та створити керівництво для лідерів щодо підвищення їх ефективності.

Дизайн/Метод/План дослідження. Для досягнення мети дослідження проаналізовано 86 статей та книг з точки зору трансформаційного лідерства, результативності команди та взаємозв'язку між цими двома концепціями.

Результати дослідження. Лідерство – одне з важливих слів у сьогоднішньому організаційному напрямку. Незважаючи на це, трансформаційне лідерство приділяє велику увагу теорії лідерства. Проведено декілька досліджень з аналізу взаємозв'язку між трансформаційним лідерством та ефективністю команди. Отримані дані показують, що трансформаційне лідерство залишається найважливішим стилем лідерства для підвищення ефективності роботи команди.

Теоретичне значення дослідження. Теоретичне значення цього дослідження розширює думки та змінює суджень для оцінки роботи щодо якості трудового життя.

Практичне значення дослідження. Практична перевага цього дослідження полягає в тому, що воно надає рекомендації для менеджерів щодо правильного використання стилю керівництва для підвищення ефективності роботи команди, і як результат - їх організації.

Оригінальність/Цінність/Наукова новизна дослідження. Оригінальність дослідження полягає в тому, що вперше проаналізовано взаємозв'язок між трансформаційним лідерством та результатами роботи команди на основі дослыдження існуючої літератури за 50 років досліджень, проведених на цю тему численними дослідниками.

Обмеження досліджень/Перспективи подальших досліджень. Прогнозами подальших досліджень є аналіз взаємозв'язку між трансформаційним лідерським підходом та результатами роботи команди, додавання інших вимірів та вимірювання їх загального впливу на такі відносини.

Тип статті – теоретичний.

Ключові слова: командна продуктивність; стиль керівництва; згуртованість команди; ефективність.

Концептуальная основа трансформационного лидерства как влиятельного инструмента в работе команды

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Цель работы – выявить взаимосвязь между подходом трансформационного лидерства и результативностью команды, проанализировать существующую литературу, в которой выражается роль трансформационного лидерства в эффективности команды, и разработать руководство для лидеров по повышению их эффективности.

Дизайн/Метод/План исследования. Для достижения цели исследования проанализировано 86 статей и книг с точки зрения трансформационного лидерства, эффективности команды и взаимосвязи между этими двумя концепциями.

Результаты исследования. Лидерство – одно из важнейших слов в современном организационном направлении. Несмотря на это, трансформационное лидерство уделяет большое внимание теории лидерства. Проведено небольшое количество исследований по анализу взаимосвязи между трансформационным лидерством и работой команды. Полученные данные показывают, что трансформационное лидерство остается наиболее важным стилем лидерства для повышения эффективности команды.

Теоретическое значение исследования. Теоретическая значимость этого исследования расширяет мнения и измененет суждения при служебной аттестации о качестве трудовой жизни.

Практическое значение исследования. Результаты исследования формулироуют руководящие принципы для менеджеров по правильному использованию стиля лидерства для повышения производительности своей команды и, как следствие, своей организации.

Оригинальность/Ценность/Научная новизна исследования. Оригинальность исследования заключается в том, что впервые проанализирована взаимосвязь между трансформационным лидерством и работой команды на основе изучения существующей литературы за 50 лет исследований, проведенных по этой теме многочисленными исследователями.

Ограничения исследований /Перспективы будущих исследований. Прогнозы для дальнейших исследований состоят в том, чтобы проанализировать взаимосвязь между трансформационным подходом к лидерству и производительностью команды, добавить другие параметры и измерить их общее влияние на такие отношения.

Тип статьи – теоретический.

Ключевые слова: командная производительность; стиль руководства; сплоченности команды; эффективность.

1. Introduction

Nowadays, leadership has a vital role in the organization's leading process. The theory of transformational leadership provides a way to enhance our understanding of team performance (*Dionne et al., 2004*). According to *Salas et al. (1992)*, considering the extensive formation of teams in all types of organizations now is the time to integrate transformational leadership theory with team performance theory. The word "leadership" is very popular these days. There are various books on leadership, and what makes a good leader. Moreover, all need to be leaders, and some people are born leaders, and some can develop as leaders.

Let present a brief history of the process of world "management/leadership." We have seen the word "management" has changed over the years. This process described *Adizes (2004 a)* as in order to understand the role of leadership in organizations and the importance of a complementary team, which makes the team more productive. He described the process as: "The word that was originally used to describe the process was "administration." Therefore some business schools are called Graduate Schools of Business Administration, and some that are involved in managing and have the diploma to prove that they have been professionally trained, and are Masters of Business Administration, and the first such journal was the Administrative Science Quarterly. Nevertheless, as administrators failed to show desired results, the word "administrator" is now mostly used in the "bureaucratic" meaning.

It brought a new word: "management." And educational institutions became Graduate Schools of Management instead of Administration. However, failing to achieve the desired outcomes, the word "management" got denoted causing the advent of a new word: "executive"; hence, the terms "executive training," "executive action," and, "Chief Executive Officer." After that, the word "leadership" emerged (2004).

Although there are numerous publications about how leadership is different from the administration, and from executive action, which is itself different from management (*e.g., Kotter, 1990*), suggest that this new fad will not work either. There will not be a surprise if in the future there emerged a new word to define the process, while the word "leadership" gets another meaning for some piece of the managerial process or hierarchy, like in the case with "administration" and "management" words. Yet, the paradigm remained the same, as the entire managerial process is continually personified in a sole individual (administrator, manager, executive, and leader). That is a manifestation of the American culture of individualism (*Ross & Kami, 1973*)."

There is still individualizing and personifying the process of management. Changing the name when amplifying the concept sometimes changes the phenomenon. Whether it is an administrator, a manager, an executive, or a leader – the paradigm is still the same, and that is why it does not work. The expectations that a single individual can manage anything. That, we need a complementary team. Furthermore, leaders make the team to be complementary and to achieve desired results.

Adizes (2004 b) stressed that leadership is like a thumb. As the thumb is the only finger that opposes the other elements of the hand and, by integrating them, helps them work together like a hand. So, *Adizes (2004 b)* have used that analogy to describe the role of leadership as a key to create a complementary team. In this case, it raised a question (*first question*): which kind of leadership is more critical to creating a complementary team to increase the team performance? *Tracy (2014)* said we need two types of leaders: the first type is transactional, and the other is transformational. One has to choose either type to make a more detailed analysis, so it was followed by raising another question (*second question*): which is the more important of them two?

According to *Robbins and Judge (2016)*, transformational leadership yields many desirable organizational outcomes. While *Tyssen et al. (2014)* compared transformational leadership with transactional leadership; research indicates that transformational leadership more strongly correlates with lower turnover rates, higher productivity, lower employee stress and burnout, and higher employee satisfaction, than transactional leadership. Other authors *Robbins and Judge (2016)*, which compared these two types, stressed that transformational leadership builds on transactional leadership and produces follower effort and performance beyond what transactional leadership alone. However, the reverse is not valid. If there is an excellent transactional leader without transformational qualities, he will likely remain just a mediocre leader.

While *Tracy (2010)*, differentiation based on vision. He said that the quality of vision changes a "transactional manager" into a "transformational leader." A transformational leader is a leader who finds new alternatives. That is a visionary leader who motivates, encourages, inspires, and gives others the authority to show themselves on a level much higher than they have been before (*Tracy, 2014*). According to *Lowe &Kroeck (1996) and Judge and Bono (2000)*, transformational leadership has drawn much attention to leadership research in the last two decades. Also, *Liang et al. (2011)*, on an empirical study, found that transformational leaders affect followers to display more task performance than transactional leaders do.

These statements had a massive impact on the decision to analyze the role of transformational leadership. On the other side, besides transformational leadership, this article is focused, and on the team[1] performance. The importance of teams is increasing day by day, and a lot of researches witnesses this (e.g., *Salas et al., 1992; Montoya-Weiss et al., 2001, Islami et al., 2018; Farahnak et al., 2019; Lorinkova& Perry, 2019; Islami&Islami, 2019; Butar et al., 2019*), who stressed that teams could adequately provide a directed and collaborative effort to address complex task concerns, organizations around the world have significantly increased their dependency on teams.

Stout et al. (1997) indicated that even though the trust in teams has increased much since the early 1980s, researchers could not meet compliance with the growing need to understand how teams can gain more effective performance. The new question arises (*third question*): how can these two concepts (transformational leadership and team performance) be linked together? According to *Krishna (2011)*, a small number of researchers have studied the impact of leader behavior on team performance, even though team performance is critical because changes are taking place in the work environment. He added that organizations are shifting toward team-based work culture, and leadership at the team level has become pivotal for the successful performance of teams.

Fellow question (*fourth question*): Who are the primary authors that have studied transformational leadership and team performance simultaneously, and the influence on each other? The primary researchers who have analyzed the transformational leadership and team performance derived from the most significant number of other authors are (*Burns, 1978; Bass, 1985, 1990; Atwater &Bass, 1994; Yammarino, 1996; Bass et al., 2003*). The evidence suggests that transformational leadership and team performance may be fruitful areas for further exploration (*Dionne et al., 2004*). There was some effort to link team performance with transformational leadership (*Bass, 1990; Yammarino, 1996*); however, without explicit relationships to teamwork processes

[1]The team. This paper follows Guzzo & Dickson's (1996) example and use the terms "team" and "group" interchangeably, even though it is a common knowledge that these two terms may be distinguishable. Also, in this paper, we use interchangeability terms "members of the team" and "followers," however, they are different in meaning.

and skill sets. By analyzing the mentioned authors above is seen only in the positive relationships between elements of transformational leadership and team performance.

So, there appeared *fifth question*: If there is any research article that has criticized the role of transformational leadership on team performance? *Van Knippenberg and Sitkin (2013)* criticized transformational leadership; he has gone even further in predicting the decline of transformational leadership, followed by the advent of some new theories value-based, which some believe that those new theories could replace transformational leadership (*for more see Dinh et al., 2014; Van Knippenberg, 2015*). Nevertheless, neither of the new theories could explain the significant amount of variance in leadership outcomes above and beyond transformational leadership, and according to (*Hoch et al., 2016*), transformational leadership predicted better the team performance than new theories.

This findings' divergence led to the final question, which shows the most critical question in this study, which may become an objective of this paper (*sixth question*): Could organizations using the transformational leadership improve the team performance? A longstanding approach to this question got focused on the effects of leaders on team performance. That is because, according to *Mehra et al. (2006)*, team leaders play a pivotal role in shaping collective norms, helping teams cope with their environments, and coordinating collective action.

2. Literature review

2.1. Transformational leadership

The transformational leadership concept was formulated by *Burns (1978),* who described the transformation of leadership as a process where "leaders and followers gain higher levels of morality and motivation." Later, leadership author *Bass (1985)*, whose theory of transformational leadership was based upon Burns' earlier ideas, with several modifications or elaborations. According to him, transformational leadership is defined in terms of the leader's effect on followers: they feel trust, admiration, loyalty, respect toward the leader, and they are motivated to do more than they initially expected to do (see also *Mullins, 2010; Doucet et al., 2015; Robbins & Judge, 2016*).

The research in this field of leadership was continued with empirical studies, by authors (*Bass & Avolio, 1994; Lowe et al., 1996*), who reported that transformational leadership significantly increase transactional leadership, resulting in higher levels of individual, group, and organizational performance. Transformational leadership may be directive or participative. According to *Bass (1999)*, transformational leadership is recognized universally as a concept that requires higher moral development. The construct notion of a transformational leadership style was part of work for many scholars (*House, 1977; Bass 1985; Trice & Beyer, 1986; Tichy & Devanna, 1986; Conger & Kanungo, 1988; Yukl, 1989; Podsakoff et al., 1990; Atwater & Bass 1994*).

Additionally, *Krishna (2011)* that analyzed the *Bass (1985)* findings, found that Bass considers that transformational leaders transform and motivates followers by making them more aware of the importance of task outcomes, stimulating them to transcend their self-interest for the interest of the organization or team, and activating their higher-order needs.

Also, *Mullins (2010)* has studied the impact of transformational leadership on followers; he stressed that transformational leadership is a process of bringing a high level of motivation and commitment among followers. Transformational leaders use idealized influence, inspiration and motivation, intellectual stimulation, and individualized consideration to achieve superior results by the team (*Avolio et al., 1999*). Besides, *Rowold (2005)* tried to find what possible positive impact of the transformational leadership might have on followers' satisfaction, extra effort, and leaders' effectiveness.

In this case, *Mullins(2010)* stressed that many researchers saw transformational leadership as the same thing as charismatic, visionary, or inspirational leadership. It is worth mentioning that entirely the same opinion does not exist (*Robbins & Judge, 2016*), who tried to distinguish between transformational leadership and charismatic leadership, and he found that, even though these two concepts have some commonalities, there are differences too. He stated that charismatic leadership allocates more emphasis on the way that leaders communicate (whether they are passionate and dynamic), while transformational leadership focuses more on the subject of their communication (on a compelling vision). And there are more common than differences in the theories. They are motivated to both focus on the leader's ability to inspire followers, and sometimes they do so in the same way. That enables some researchers believe the concepts are somewhat interchangeable. After analyzing available literature, we can say that transformational leadership nowadays is a key for developing groups and organizations as a whole.

2.2. Team performance

Mullins (2010) suggested that management of a multicultural workforce has become an increasingly prevalent activity and so models of culture should enable managers to work with diverse groups of people and where appropriate create effective teams. While Zaccaro and Klimoski (2002) said that to be a team with reliable performance, the team should drive from some fundamental characteristics: team members need to integrate their actions. Teams successfully require to perform in complex and dynamic environments. Team leadership represents a third characteristic of capable team performance. With the effective application and proper training (*Tannenbaum et al., 1992*), teams could lead to increased production, morale, creativity, and innovation (*Dess & Miller, 1993*).

Jung and Sosik (2002) noted that understanding the complex interaction among transformational leadership, empowerment, and group cohesiveness affects group members' collective efficiency and group effectiveness. As more organizations use team-based work systems, we believe that it is essential for researchers to evaluate the role of leadership in group processes that make teams more productive. Team process-based performance may include levels of collective effort expended or the quality of interpersonal relationships (*Klimoski & Mohammed, 1994*). Also, *Glickman et al. (1987)* refer to as a "teamwork" focus on performance as opposed to a "task work" focus. They represent team performance as a teamwork process that enables theoretical links of interpersonally based processes that frequently present in all teams, such as communication, conflict management, and cohesion (*Dionne et al., 2004; Mulolli et al., 2015*).

2.3. Is team performance dependent on the transformational leaders' behavior?

Based on *Miles (2012)* described role model theory, and as a role model, it refers to a person who serves as a behavioral example that others follow. Based on the state "behind a good military stands a good commander," by this, teams tend to be like a mirror image of their leaders. Depending on the style of leadership adopted will influence the relationship between the group and the organization and are significant issues of group cohesiveness. Generally, cohesiveness will be affected by such things as how the manager gives guidance and encouragement to the group, offers help and support, provides opportunities for participation, attempts to resolve conflicts, and gives attention to both employee relations and task problems (*Mullins, 2010*).

McKenna and Maister (2002) draw attention to the importance of the group leader, establishing a level of trust among the group by helping them understand the behaviors that build trust. "The group leader's job is to motivate people to win the trust of others within a group, followed by showing them how it can translate into greater commitment, greater creativity, greater professional

satisfaction, and better performance." Whereas, *Dionne et al. (2004)* state that team cohesion is positively linked with team performance. Why the cohesive teams have a better performance than not cohesive? Authors found the answer to this question (*Swezey& Salas, 1992*) - cohesive teams tend to reduce the level of absenteeism, high involvement in team activities and high involvement in team activities and high levels of member coordination when solving problems, (*Shaw, 1971*); in the cohesive team the members more motivated to remain on the team compared with a not cohesive team.

Mullen and Copper (1994) have done meta-analysis research, from which they found a significant relationship between the cohesion and performance teams. Teamwork processes include cohesion and conflict management, improving team performance, and functioning (*Evans & Dion, 1991*). Who can increase more team cohesion and, as a result, team performance? Different authors found the answer; *Farrell (2009)* makes the point that leaders are ultimately responsible for creating a balance in the workplace and should take the lead in setting standards of behavior in teams. *Kahai et al. (2000) and Balthazard et al. (2002)* have analyzed the specific dimensions of transformational leadership; including (idealized influence/inspirational motivation, individualized consideration, and intellectual stimulation) may produce key intermediate outcomes that could positively impact team interpersonal processes. Moreover, it may improve team performance, on that premise rests the general transformational leadership-team performance proposition.

Numerous authors have studied the links between transformational leadership and team performance. *Bass and Avolio (1994)* showed the role of transformational leadership in improving team decision-making skills. While *Kahai et al. (2000)* found that if transformational leadership is instrumental in overcoming social loafing among group members, they are likely to increase group performance. In terms of improving multi-functional team innovation processes, transformational leadership was analyzed (*Waldman, 1994*).

In addition to research for the relationship between transformational leadership and team performance, there was created *Table 1* with the analyzed different elements of transformational leadership and the team performance. This table illustrates more clearly the methodological approaches that are used by previous authors to find this relationship.

There was created a conceptual model of this paper (see *Fig. 1*) to show the process of how transformational leadership impacts on team performance. The primary attention should be on the middle four squares, which present the black box of this process.

3. Methodological approach

This section presents the philosophical assumptions and the used method of collecting data.

3.1. Philosophical assumptions

According to *Creswell et al. (2007)*, philosophical assumptions guide researchers in setting up the appropriate methodologies for their research. In order to support the methodology used in this study is to explain the ontological and epistemological concept used in this study. *Lapersonne (2018)* said that a long debate had been established in science on the nature of what is reality. On the one hand, there is a realism perspective that has a detailed view of the world and, independently, if the observation has a direct or indirect correspondence to the phenomena being observed, it defends that the process of observation does not have any influence on the phenomena being studied. On the other hand, we have the relativism perspective that perceives the world as mutable and understands that observation influences the object of study.

This traditional debate has been transferred into the domain of social science in two central ontological positions: representationalism and relativism. This study adopted the critical realism point of view, an intermediate ontological position between the two extreme perspectives of representationalism and relativism. Critical realism differs from the naive view of representationalism that believes that this reality could be directly accessed and controlled. Critical realism defends that the knowledge of this reality is socially constructed and consequently does not directly represent the reality but a representation of it among several *Lapersonne, (2018)*. In this study, it is believed that an ontological approach based on critical realism will be necessary to understand the nature of the transformational leadership and team performance concepts that have been oversimplified by empirical studies.

3.2. Data Collection

When it comes to realizing this study, secondary data was used to conduct an extensive search for both published and unpublished transformational leadership and team performance. The article used secondary data analysis like as scientific publications and articles from specialized databases, such as Web of Science, Scopus, Emerald, Springer, and ProQuest, EBSCO, WorldCat, EBSCO, and Google Scholar. The way of finding articles is using the internet and searching for articles that have trait transformational leadership and team performance concepts, as well as the relationship between these two concepts. For the study of the relevant articles, books, conferences, and periodicals, we also applied the snowball technique when checking the reference lists. The keywords used in literature searching were: ("transformational" or "leadership") and ("team" or "performance" or "cohesion" or "effective").

4. Results

4.1. Descriptive analysis

This section presents the articles and books published before, and that become inputs for this research article in different aspects. Fig. 2 represents outcomes, methodology from several articles, books, and other sources (in terms of time distribution).

Fig. 2 shows that the research literature covers about 50 years of study. Moreover, the interest of this field is growing.

Whereas *Fig. 3* depicts the literature by field of study. The literature in question is here to divide the result categorizes into five specific groups. The first group "leadership and other articles" covers 19 documents, mainly articles and books which contain leadership, while other documents are the literature that was source for some exciting thing for the methodological part. The other important information presented in *Fig. 3* with the fourth group covers all articles and books analyzed in some relationship between transformational leadership and team performance.

Fig.4 represents only articles with transformational leadership and team performance by year.

Fig. 4 shows the importance of this relationship by years, for the last 40 years, the authors have tried to link those two concepts because before that time, those two concepts had been studied separately. Transformational leadership is currently the most widely researched leadership concept (*Braun et al., 2013*).

Table 1

Previous researches for transformational leadership on team performance*

Authors	Study	Methodological approach	Outcome
Sosik et al. (1998).	Analyzed the relationship between transformational leadership and dimensions of creativity.	Qualitative analysis	Team working under higher transformational leadership levels generate more idea elaborations and original solutions than groups working under lower levels of transformational leadership.
Jung and Sosik (2002).	Transformational leadership in workgroups: the role of empowerment, cohesiveness, and collective-efficacy on perceived group performance.	Quantitative method; A survey instrument; Econometric analysis.	Transformational leadership related to empowerment, group cohesiveness, and group effectiveness.
Dionne et al. (2004).	Links between transformational leadership and team performance.	Analysis of available literature.	The transformational leadership theory integration within team performance and development is somewhat complicated; we can be encouraged in this effort by an enormous payoff – there are many examples of how transformational leadership has promoted performance beyond expectations.
Lim and Ployhart (2004).	Transformational leadership: relations to the model of five factors and team performance in typical and maximum contexts	Econometric analysis	They found that transformational leadership appears to be more critical for team performance under a maximum performance context than a typical performance context. There was suggested that future research should address the limitations present in this study to help building theories linking transformational leadership to collective performance in typical and maximum contexts.
Eisenbeiss et al. (2008)	Transformational leadership and team innovation: Integrating team climate principles.	Data were obtained by Questionnaire and Interview; Econometric analysis	Organizations can influence supportive behavior for innovation by promoting a transformational leadership style among team leaders through selection and leadership development programs, because of transformational leadership was shown to predict support for innovation.
Krishna, (2011).	Effects of Transformational Leadership on Team Performance	Quantitative method; The instrument of collecting data Questioners; Econometric analysis.	It is found a positive relationship between transformational leadership and team performance. Also, that transformational leadership is associated with effectiveness, extra effort, and satisfaction. Is proposed the need for developing transformational leadership training programs in Informational Technology (IT), IT-enabled, and Knowledge Processing services via structured leadership interventions designed to bring about a positive change in employee confidence, attitudes, and performance.
Wang et al. (2011).	Transformational leadership and performance along with criteria and levels: an analytic 25 years' research review.	Search for published and unpublished transformational leadership; Meta-analysis.	Transformational leadership was related to individual-level follower performance across criterion types, with a stronger relationship for contextual performance than task performance across most study settings. Besides, transformational leadership was positively related to performance at the team and organization levels.
Eisenbeiss and Boerner (2013).	It is a dual definition: Transformational leadership and individual creativity.	Participation meant that some of the organization's R&D employees would have to answer a web-based survey; Econometric analysis.	Transformational leadership positively influenced workers' creativity, but suggested leaders need to guard against dependent leader relationships, which lower employee creativity.
Prochazka et al. (2017)	Transformational Leadership, Work Satisfaction, and Group Performance	Questionnaire; Econometric analysis	Group transformational leadership related to group performance partially through group work satisfaction. The mediation effect was substantial but significant only at a 10% level because of the limited number of teams (clusters).

*Source: compiled by Authors.

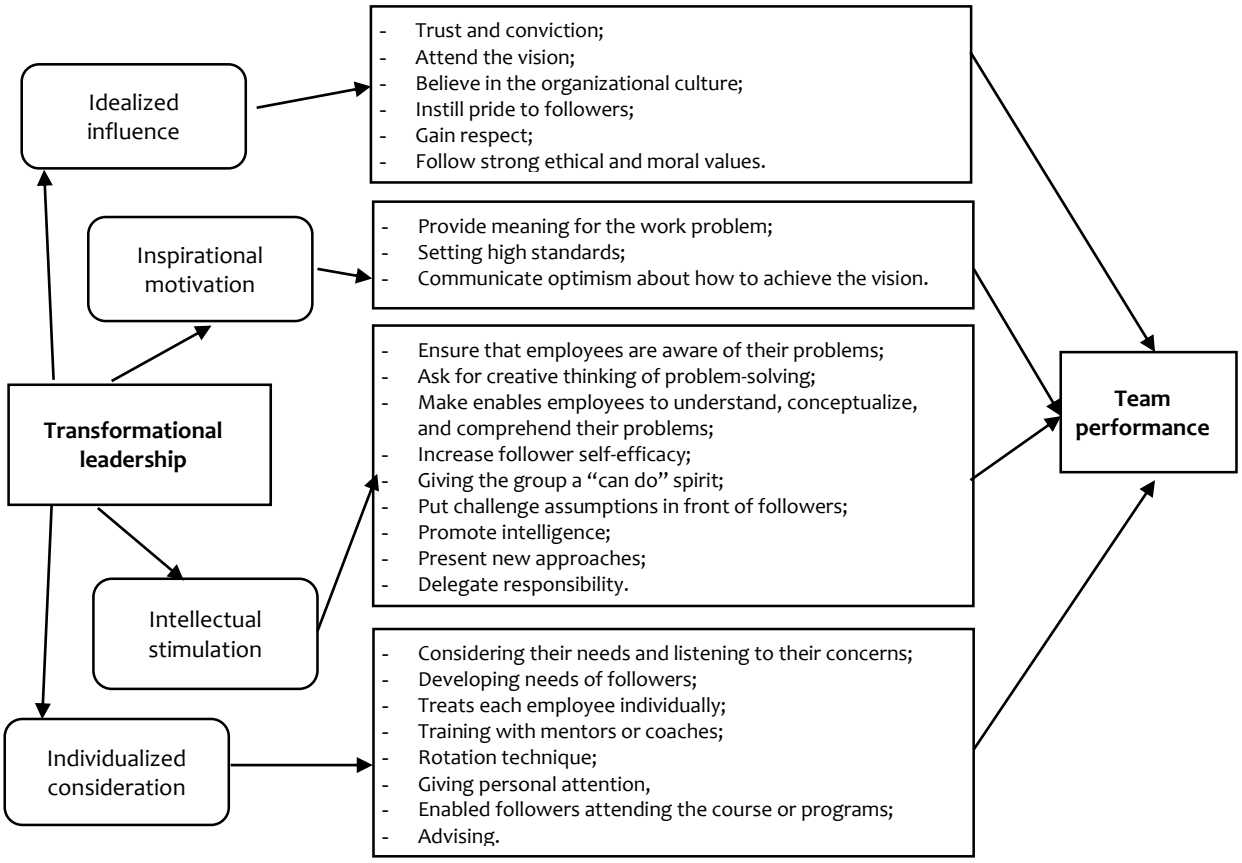

Fig.1. Conceptual model*

*Source: compiled by Authors.

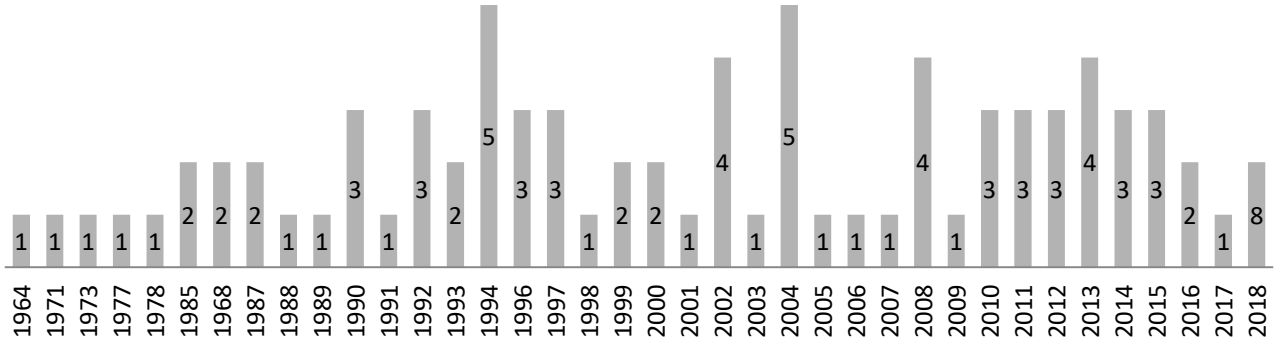

Fig. 2. Number of articles by published date*

*Source: compiled by Authors.

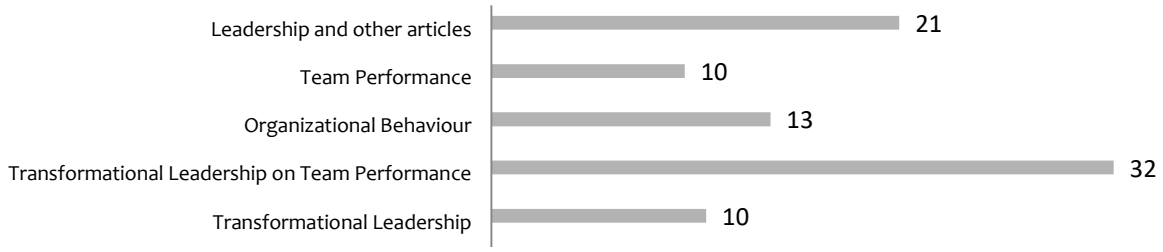

Fig.3. Articles according to a specific field of study*

*Source: compiled by Authors.

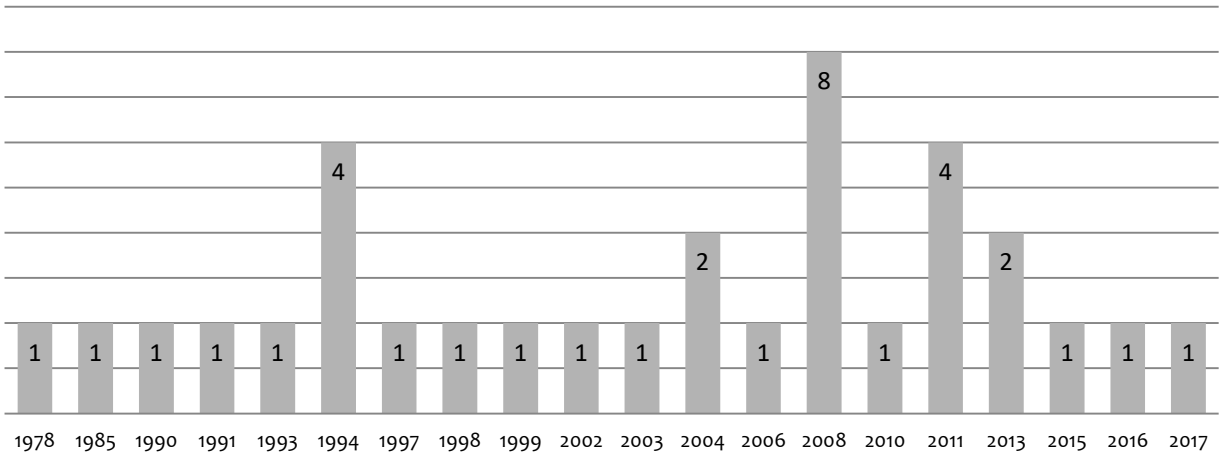

Fig.4. Articles, the role of transformational leadership on team performance by publishing date

*Source: compiled by Authors.
**Note: authors (n=32).

5. Discussion

This section presents the findings from the studied literature, with the main focus on the relationship between transformational leadership and team performance. As *Fig. 1* shows how the transformational leadership process influences team performance. The process started with transformational leadership, which is contained by four primary components, idealized influence; inspirational motivation; intellectual stimulation; and individualized consideration. These four components explain all the role of transformational leadership, as we know from previous research studies that teams have to be effective if any of these components are applied in an organization. Section (5.1) explains how leaders should use these factors in order to increase team performance.

Fig. 2, 3, and 4 depict the data for studied literature; all data sources for this study have explained how transformational leadership and team performance. Even though, if we look the references we will see some articles which have a strange title, and they give as in first look an idea that they do not speak for these two concepts, but inside of them can find a very rich data and information for transformational leadership, team performance, or for the linkage between them.

In this part, it is worth analyzing and discussing the model proposed by *Dionne et al. (2004),* one of the few authors who studied the transformational leadership on team performance with a model. His model emphasizes how transformational leadership can impact teamwork processes through a variety of intermediate outcomes, and as a result, how can impact team performance. *Dionne et al. (2004)* have well described and supported all the seven propositions, in order to make more apparent the model, here shows the propositions: (P1) team cohesion positively predicts team performance; (P2) open and prompt team communication positively predicts team performance; (P3) positive team conflict management actions positively predicts team performance; (P4) creation of shared vision positively impacts team cohesion, and partially mediates the relationship of idealized influence/inspirational motivation leadership with team performance; (P5) commitment to the leader positively impacts team cohesion, and partially mediates the relationship of idealized influence/inspirationally motivating leadership with team performance; (P6) a leader's empowerment of team members positively impacts team communication and partially mediates the relationship of individually considerate leadership with team performance; (P7) a leader's creation of functional conflict positively impacts team conflict management, and partially mediates the relationship of intellectually stimulating leadership with team performance.

All of these propositions are applicable if we use a transformational leader like a person who leads the team and organization because only this kind of leader type can make them enforceable to all *Dionne et al.*, propositions. At the same time, *West (2012)* explains where transformational leadership is proper to use to increase team effectiveness and performance. He said a supportive (transformational) style that involves showing concern for followers is more appropriate when the task is obvious and predictable, but the team members have a low level of skill, ability, confidence, or motivation (*West, 2012*). According to him, transformational leadership also involves stimulating team

members by painting an attractive, compelling picture of what they can accomplish and the means to accomplish it. That requires thinking through what the team is trying to achieve, developing wise and practical plans for success, and then communicating, discussing, and selling these plans to the team. They get an increased awareness of the problems, their importance to the organization, and will be motivated to achieve the goals and perform their tasks well.

West, (2012) explains the way how leaders can improve team performance, leaders transform their team members by devoting a good part of their considerable energy to thinking through how to help members of the team develop their knowledge, skills, abilities, and careers, and discussing and planning this with them. By doing this, they focus on their development, increase their skills and confidence, and satisfy the need to grow, develop, and discover through engaging with our environments. In addition to this, below is presented how transformational leaders will increase team performance.

5.1. A guideline for using transformational leadership on the team

This part represents the steps that leaders should attend to make their teams more productive and, consequently, increase the team's performance. Leaders try to create a capable team with excellent performance for the organization, but to do this, they should motivate them to work together to achieve the desired goals. If members of the team are motivated, their performance will increase. People require abilities and motivation to increase team performance, *Vroom (1964)* found that if the abilities or motivation is zero, there will not be the effective performance, Performance = f (Ability x Motivation).

*Bass (1985)*has described a theory that four essential components contain transformational leadership: (1) idealized influence; (2) inspirational motivation; (3) intellectual stimulation; and (4) individualized consideration (for more explanations about these four components see, *Howell & Avolio 1993; Bass 1997; Bass 1999; Judge & Piccolo 2004; Mullins, 2010; Miles, 2012; Prochazka & Vaculik, 2015; Robbins & Judge, 2016).*

This compound of transformational leadership displayed some factors that a leader should have to increase team performance because and other behavioral parameters that increase team performance are included in those four components of transformational leadership. The below guideline is for leaders who try to move forward their team's performance and is based on a conceptual model created for this study.

First, leaders should behave and perform only those things that they want to see on their followers, because, if they share respect to followers, they will be admired and the followers tend to be identified with them. So, leaders should act as role models for their followers. To increase the team members' productivity and, consequently, the whole team performance, leaders need to distribute some attributes and behaviors suitable for them and applicable by team members who want to imitate those behaviors. In this case, leaders should:

– Display trust and conviction;
– Attend the vision;
– Believe in the organizational culture;
– Instill pride to followers;
– Gain respect, and
– Follow strong ethical and moral values.

Ling et al. (2008), which have analyzed the transformational leaderships' role, found that transformational leaders generally have greater decentralization of responsibility, managers with more propensities to take risks, and compensation plans geared toward long-term results.

Second, leaders should motivate; they need to find a way to motivate followers. There is no only one way to motivate the people; some people are motivated by financial aspects, others by private carrier (moral or material things), so the leader should speak with each member of the team to find what motivated them. *West (2012)* used some examples to show what should do the transformational leader to increase followers' motivation (leaders should provide meaning for the work task, set high standards, and communicate optimism about the achievability of the vision). Also, *Liu et al. (2010)* said that transformational leaders also obtain higher levels of trust, which reduces stress for followers. On the other side, *Asrar-ul-Haq and Kuchinke (2016)* found that transformational leaders motivate their followers to go beyond rewards and exchanges. Leaders should have an optimistic view and set high standards for followers. If they put a high standard for the member team, they will be more motivated because they feel enthusiastic and encouraged to accomplish higher goals.

Third, leaders should stimulate and encourage creativity to their followers. Transformational leaders should ensure that employees are aware of their problems and capable enough to think about their problems creatively. According to *Garcia-Morales et al. (2008)*, transformational leaders are more effective because they are creative and encourage followers to be creative. Transformational leaders should make employees understand, conceptualize, and comprehend their problems; it enables employees to analyze and solve problems in unusual ways *(Bass & Avolio, 1997)*. Creativity is the key to organizational success, and transformational leaders can increase follower self-efficacy, giving the group a "can do" spirit *(Walumbwa et al., 2008)*.

To do this, leaders should provide meaning, and they need to challenge the followers with the new works. It means that leaders should put challenge assumptions in front of followers, ask for creative thinking of problem-solving, promote intelligence, present new approaches, and delegate responsibility to team members. *Robbins and Judge (2016)* stressed that individually focused transformational leadership is behavior that empowers individual followers to develop ideas, enhance powers, and increase self-efficacy. Whereas, team-focused transformational leadership emphasizes group goals, shared values and beliefs, and unified efforts. So, according to these statements, leaders should:

– Stimulate and encourage creativity to team members;
– Enables employees to analyze and solve their problems;
– Increase team members self-efficacy;
– Giving the group a “can do” spirit;
– Put challenge assumptions in front of team members;
– Ask for creative thinking of problem-solving;
– Promote intelligence;
– Present new approaches; and
– Delegate responsibility to members of the team.

Fourth, leaders should pay special attention to each follower individually, listen, and concern for the growing and developing needs of followers. Leaders achieve this they should:

– Treats each employee individually;
– Develop team members;
– Training them with mentors or coaches;
– Apply the rotation technique;
– Giving personal attention to team members;
– Enables to followers attending the course or programs;
– Advise team member; and
– Pay attention to their needs and listening to their concerns.

Transformational leadership should get special attention to every employee based on one’s characteristics and needs. By listening to their employees, advise them, and teach them on an individual basis. If a leader applies the elements mentioned above, the team performance increases; without a doubt, these elements are based on numerous authors that have analyzed transformational leadership and team performance in different ways. However, in this paper, they are gathered to present whole activities and duties which should apply leaders to increase team performance. Transformational leadership should directly interact with the members of the team. To make decisions that when they report to

an external board of directors or deal with an elaborate bureaucratic structure.

A few authors have created transformational leadership guidelines in this study and presented one author's guideline (Yukl, 2013). His guideline contains six elements which are presented below: (1) Articulate a clear and appealing idea of what the organization could accomplish or become to help people understand the purpose, objectives and priorities of the organization, and to help guide the actions and decisions of members; (2) Explain how the an idea can be attained and establish a clear link between the vision and a credible conventional yet straightforward strategy for attaining it; (3) Act confidently with the optimism about possible success, demonstrate self-confidence and conviction, and emphasize positive aspects of an idea instead of obstacles and dangers; (4) Express confidence in followers and their ability to carry out the strategy to achieve the aim, especially when the task is difficult or dangerous, or when members lack confidence in themselves; (5) Use dramatic, symbolic actions to emphasize fundamental values and demonstrate leadership behavior through dramatic, highly visible actions including risking personal loss, self-sacrifice or acting unconventionally; (6) Lead by recognizing actions speak louder than words, however exemplary behavior in day-to-day interactions with subordinates and by demonstrating consistency in daily behavior (cited by Mullins, 2010). This guideline, according to the previous researches, will increase team performance by using transformational leadership.

6. Conclusion

Transformational leaders have an extraordinary effect on the team, causing higher team performance. In recent years, several researchers have criticized transformational leadership (e.g., Van Knippenberg&Sitkin, 2013; Dinh et al., 2014; Van Knippenberg, 2015). Nevertheless, transformational leadership enables a better prediction of team performance than any other theories (Hoch et al., 2016). The previous study regarding the transformational leaders suggests that they are most effective when their team members can observe the positive impact of their work through direct interaction with customers or other beneficiaries (Grant, 2012). On the whole, organizations perform better when they have transformational leaders (Robbins & Judge, 2016).

Team leaders can develop their transformational leadership learning to be optimistic (not unrealistic) and expressing positive emotions in the form of enthusiasm, excitement, appreciation, pleasure, contentment, and celebration rather than negative emotions such as anger, anxiety, discontent and irritation West (2012). In addition to these primary conditions, dream-teams are characterized by transformational leadership that reinforces an inspiring and motivating team purpose-focused sharply on the needs of the team's stakeholders (e.g., customers) with encouragement for all team members to value the diversity of its membership West (2012). Transformational leadership is the type of leadership that is necessary today in this globalization market, as Mullins (2010) noted that increasing business competitiveness and the need for the most effective use of human resources have resulted in publications on management focusing attention on how leaders revitalize or transform organizations.

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8. The competing interests

The authors declare that they have no competing interests.

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Management of the process of formation and realization of competitive advantages of the Visegrad Four countries in the European market of ICT services

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Purpose – to assess the integration and management of the formation and implementation of the competitive advantages of the Visegrad Four countries in the European market of information, computer, telecommunication (ICT) services based on their analysis in the individual market segments.

Design/Method/Research approach - this study aims to determine the presence and nature of the competitive advantages of countries in the European ICT services market based on the calculation of export specialization indicators, to establish factors for their growth and effective implementation based on the results of structural, regressive, comparative analysis and synthesis .

Findings. It has been suggested that the introduction of the European rules for market organization stimulated the building-up in the Visegrad Four countries of their competitive advantages in the European ICT services market through innovative investment resources, effective management of private, public sector and international investors and personnel.

Practical implications. The accession of Eastern European countries to the European digital market and digital space requires a generalization of the experience of the Visegrad four countries and the identification of factors, directions and priorities of the national policy for the development of the ICT sector.

Originality/Value. Scientific novelty of the study - based on the calculation of the comparative advantage index, different integration and effectiveness of managing the competitive advantages of the Visegrad Four countries, primarily the sphere of IC services to the European market (relatively high - in the Czech Republic due to state financing, moderate – in Poland due to financial support from the state, in Slovakia due to private investment in R&D, low – in Hungary), this situation requires a balanced innovation and investment strategy of the countries in the future, the training of a sufficient number of qualified IT specialists, stimulation of private investment in R&D and business cooperation with the sphere of knowledge by means of tax and administrative incentives, facilitating the transition of small and medium-sized businesses on the principles of economics 4.0.

Paper type – empirical.

Keywords: export specialization, European market, ICT services, national strategies, innovation and investment factors.

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Управління процесом формування та реалізації конкурентних переваг країн Вишеградської четвірки на європейському ринку ІКТ послуг

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Мета роботи – дати оцінку інтегрованості та управлінню процесом формування та реалізації конкурентних переваг країн Вишеградської четвірки на європейському ринку інформаційних, комп'ютерних, телекомунікаційних (ІКТ) послуг на основі їх аналізу та в окремих сегментах ринку.

Дизайн/Метод/План дослідження. Це дослідження націлене на те, щоб визначити наявність та характер конкурентних переваг країн на європейському ринку ІКТ послуг на основі розрахунку показників експортної спеціалізації, встановити чинники їх нарощування та ефективної реалізації за результатами структурного, регресійного, компаративного аналізу та синтезу.

Результати дослідження. Зроблено припущення, що запровадження європейських правил організації ринку стимулювало нарощування в країнах Вишеградської четвірки їх конкурентних переваг на європейському ринку ІКТ послуг за рахунок інноваційно-інвестиційних ресурсів, ефективного управління коштами приватного, державного секторів і коштами міжнародних інвесторів та забезпечення персоналом.

Практичне значення дослідження. Приєднання країн Східної Європи до європейського цифрового ринку та цифрового простору потребує узагальнення досвіду країн Вишеградської четвірки й визначення чинників, напрямів та пріоритетних завдань національної політики розвитку ІКТ сектору.

Оригінальність/цінність/ наукова новизна дослідження – на основі розрахунку індексу порівняльних переваг встановлена різна інтегрованість та результативність управління конкурентними перевагами країн Вишеградської четвірки, першочергово, сфери ІКТ послуг до європейського ринку (відносно висока – в Чехії за рахунок державного фінансування, помірна – Польщі через фінансову підтримку держави, Словаччини за рахунок приватних інвестицій у НДДКР, низька – Угорщини), що в майбутньому потребує виваженої інноваційно-інвестиційної стратегії країн, підготовки у достатньому обсязі висококваліфікованих фахівців ІТ галузі, стимулювання приватних інвестицій в НДДКР та кооперації бізнесу зі сферою знань через податкові та адміністративні стимули, сприяння переходу малого та середнього бізнесу на засади економіки 4.0.

Тип статті – емпіричний.

Ключові слова: експортна спеціалізація, європейський ринок, ІКТ послуги, національні стратегії, інноваційно-інвестиційні чинники.

Управление процессом формирования и реализации конкурентных преимуществ стран Вышеградской четверки на европейском рынке ИКТ услуг

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Цель работы – дать оценку интегрированности и управлению процессом формирования и реализации конкурентных преимуществ стран Вышеградской четверки на европейском рынке информационных, компьютерных, телекоммуникационных (ИКТ) услуг на основе их анализа и в отдельных сегментах рынка.

Дизайн/Метод/План исследования. Это исследование нацелено на то, чтобы определить наличие и характер конкурентных преимуществ стран на европейском рынке ИКТ услуг на основе расчета показателей экспортной специализации, установить факторы их наращивания и эффективной реализации по результатам структурного, регрессионного, сравнительного анализа и синтеза.

Результаты исследования. Сделано предположение, что введение европейских правил организации рынка стимулировало наращивание в странах Вышеградской четверки их конкурентных преимуществ на европейском рынке ИКТ услуг за счет инновационно-инвестиционных ресурсов, эффективного управления средствами частного, государственного секторов, средствами международных инвесторов и обеспечения персоналом.

Практическое значение исследования. Присоединение стран Восточной Европы к европейскому цифровук рынку и цифрову пространству требует обобщения опыта стран Вышеградской четверки и определения факторов, направлений и приоритетных задач национальной политики развития ИКТ сектора.

Оригинальность / ценность / научная новизна исследования - на основе расчета индекса сравнительных преимуществ установлена разная интегрированность и результативность управления конкурентными преимуществами стран Вышеградской четверки, в первую очередь, сферы ИКТ услуг к европейскому рынку (относительно высокая – в Чехии за счет государственного финансирования, умеренная – Польши из-за финансовой поддержки государства, Словакии за счет частных инвестиций в НИОКР, низкая – Венгрии), что в будущем требует взвешенной инновационно-инвестиционной стратегии стран, подготовки в достаточном объеме высококвалифицированных специалистов ИТ отрасли, стимулирование частных инвестиций в НИОКР и кооперации бизнеса со сферой знаний через налоговые и административные стимулы, содействие переходу малого и среднего бизнеса на принципы экономики 4.0.

Тип статьи – эмпирический.

Ключевые слова: экспортная специализация, европейский рынок, ИКТ услуги, национальные стратегии, инновационно-инвестиционные факторы.

1. Introduction

Joining in 2004. The countries of the Visegrad Four in the EU meant the spread of European common market rules and competition to national markets and companies in Poland, the Czech Republic, Hungary and Slovakia. In the early 2000s. the EU recognized that the future of a competitive Europe is based on innovation and investment in high-tech industries, including in the ICT field. For ICT companies and the governments of the "new" member countries, this put on the agenda the question of the formation and implementation of competitive advantages in the European market. The proclamation in 2018 by the European Commission of the prospect of building a single digital market for the EU actualizes the management of competitive advantages in the ICT services market.

Prospects for realizing the competitive advantages of the four countries in the European market are primarily associated with their successful integration into the common digital market of the EU. On the one hand, the creation of a digital market will increase the productivity of the economy based on IT technologies and the exchange of knowledge - according to the European Commission, the construction of a DSM should ensure an increase in European GDP of 415 billion euros annually (*European Commission, 2015*). According to expert estimates by McKinsey & Company, the implementation of the latest technologies (including Artificial Intelligence, big data, etc.) should ensure an annual GDP growth of the EU countries by 1.1% by 2030, or a net total increase in size 2200000000000 Euro (*European Commission, 2020a*).

The prospects for realizing the competitive advantages of the four countries in the field of ICTs largely depend on the conformity of national policies with the goals and objectives defined in the framework of the EU research and innovation policy. In particular, V4 countries must become members of the European Digital Space and Digital Single Market (DSM). The digital common market provides freedom of information flow within the EU, complementing the four fundamental freedoms of the common market. Within the digital space, European citizens and enterprises will be able to freely access information, as well as goods and services online, regardless of country of origin (*European Commission, 2015*).

According to the roadmap for building a digital common market, the implementation of 30 legislative acts is planned, 28 of which have already been considered and adopted by the European Parliament and the EU Council (*European Commission, 2018a*). In April 2019, the European Parliament adopted the Digital Common Market Copyright Directive (2019/790), the first of a package of documents within the digital common market that came into force in June of that year (*EUR-Lex, 2019*). Within two years, member countries must bring the national legislation into line with the new directive.

According to the European Commission (*European Commission, 2015*), on average, in every European country 42% of digital services are provided by national providers, 54% by US companies, and only 4% by other member countries within the common market. Building a common digital market will allow European ICT companies to provide services freely to nearly 500 million consumers throughout the common market.

2. Problem statement

The purpose of the work was to assess the management of the process of formation and implementation of the competitive advantages of the Visegrad Four countries in the European market of IC services based on the analysis of their competitive advantages and in its individual segments. To achieve this goal it is necessary to solve the following tasks: to determine the presence and nature of the competitive advantages of countries in the European market of infrared services; establish factors for increasing competitive advantages; evaluate the effectiveness of managing competitive advantages at the national level. We hypothesized that the introduction of European rules for market organization stimulated the build-up of competitive advantages in the European Visegrad Four countries in the European ICT services market through innovative investment resources and effective management of private, public sector and international investors and personnel.

3. Methodology

To determine the competitive advantages of the Visegrad Four countries after joining the EU, we calculated *Balassa (1965)* ICT services (RCA services) indices for each of them, with RCA> 1 indicating the existing competitive advantages. Comparison of the average and initial value of the B. Balassa indices for the period 2004-2017. It allowed to establish the development vector of the competitive advantages of the ICT sector, namely: building up (in the case when the average value exceeds the initial, RCA _ser> RCA _1) or loss of competitive advantages (in the case when the initial value exceeds the average, RCA _ser <RCA _1) for each country. The assessment of the resource base for the formation of competitive advantages in the European ICT services market is based on the construction and analysis of regression models between the values of the competitive advantage indices and the tested factors. Considering the results of *Bochkova (2013)* research and Eurostat statistics, the following indicators were selected as factors in the formation of competitive advantages in the European ICT services market: company spending on R&D — includes expenses of enterprises of all sizes and forms of ownership of R&D only at the expense of their own funds government spending on R&D - defined as the sum of government allocations and other expenses from the state budget for R&D; R&D expenses from funds of foreign origin - include expenses on innovations financed from funds of foreign entities, including foreign companies, European Structural Funds (ESF) and international organizations; the number of employees in R&D - the total number of people employed in research and innovation; average salary of a specialist in the field of ICT services. The calculation of the values of the level and intensity of intra-industry trade (between the countries of the Visegrad Four) made it possible to establish the nature of competition in the ICT services market. The formation of competitive advantages in industries with high trade intensity is stimulated by intense competition, and in industries with high levels of intra-industry trade, it is due to the advantages obtained through economies of scale.

We used the methods of an integrated approach, grouping, average values, structural, comparative, regression analysis and synthesis. The information base for quantitative and qualitative analysis was formed by Eurostat statistics on the development of international trade in ICT services of the Visegrad Four countries (Poland, Czech Republic, Hungary, Slovakia) for the period from 2004 to 2017.

4. Results

The process of "tertization" of economies in the countries of Central and Eastern Europe, based on the transition to market principles of management, accelerated in the Visegrad Four countries with accession to the EU. The "intensification" of the service sector is indicated not only by a change in the structure of the economy, outstripping its growth rates behind the manufacturing sector, but also by qualitative changes in the external sector — the trade and investment sectors (*Melikhova, Bazˇó, Holubcova, & Camacho José, 2015*). For example, *Zhedlichka, Kotian, & Munz (2014)* indicate the increase in the export quota of countries, and the total export of goods from the Visegrad Four countries increased more than 2.5 times during 2003-2013. One of the advantages of the common market is the demonopolization of telecommunications. *Kovárnik and Khamplova (2016)* established different dynamics of export of countries and the attraction of trade flows to Germany (*Kovárník, & Hamplová, 2020*).

Features of the development of the ICT sector of the countries studied by European authors. Thus, the influence of industry (based on the Hershintal index) and regional concentration (according to the Krugman index) ICT sectors on the growth of competitiveness in Poland, the Czech Republic, Hungary, Slovakia and Austria was studied by *Turečkova* (*2016*). Puzhova K. and Mareshova P. assessed the competitiveness of the Czech Republic's ICT industry on the world market (*Půžová, Marešová, 2014*), the "strengths" and "weaknesses" and innovativeness of the ICT sector in Hungary were identified in the work of *Fekó* (*2011*). The regional concentration of ICT complexes in Poland and the Czech Republic was the subject of research by *Schwinta* (*2014*). Thus, the main attention of the authors is focused on the internal laws of the development and competitiveness of the ICT industry, the issue of export specialization and market integration after entry into the EU remain outside the focus of the study.

Szent-Ivany (*2017*) points to the different priority of the ICT sector for foreign direct investors of the four countries. So, for the Czech Republic - 8th place, Poland - 7th, Slovakia - 5th, Hungary - 4th place. The author has identified three groups of challenges that FDI promotion countries of the Visegrad Four are facing, but are still not coping with, including: the changing competitive advantages of V4; the dubious effects of FDI in the long run; the volatile nature of multinational production.

The approximation of the economic structure of the Visegrad four European countries means the formation and deepening of export specialization in the services sector of countries based on comparative / competitive advantages. The most comprehensive study of the competitive advantages of countries, regions and individual firms is presented in M. Porter, the author of the competitive advantage rhombus theory and the theory of the four stages of development of the national economy (*Porter, 1990*). The tools and methods for quantitative assessment of comparative and competitive advantages are given in the work of *Balass* (1965), *Volrat* (*Vollrath, 1991*).

According to the results of 2017, among the four countries only in the Czech Republic and Slovakia competitive advantages expressed by RCA indices > 1 were found. Hungary and Poland showed comparative advantages with the indices of 0.74 and 0.90, respectively.

Table 1

- Competitive advantages of V4 countries and the dynamics of their development in the European ICT services market, 2017 *

Indicator	Czech Republic	Hungary	Poland	Slovakia
Identified comparative and competitive advantages of countries				
RCA_{2017}	1,20	0,74	0,90	1,28
Advantages nature	Competitive	Comparative	Comparative	Competitive
Dynamics of development of comparative and competitive advantages				
RCA_{2004}	0,40	0,80	0,41	0,69
RCA_{cep}	1,00	0,80	0,65	0,91
Growth Rate	2,50	1,00	1,60	1,31

*Source: calculated by the authors based on data *(Eurostat, 2019)*.

Balassa average indices for 2004-2017 are given in table 1. When comparing with the indices for 2004 it can be concluded that all four countries have shown increasing comparative or competitive advantages for the period of EU membership. According to the growth rate, the Czech Republic and Poland showed the greatest value. In Hungary alone, the Balassa index for 2017 was below the 2004 figure and low among the four countries, indicating a relative "closed" market. Our results do not contradict the conclusions of *Turečková* (*2016*), which indicates the narrow industry specialization of the ICT market in Hungary.

A comparative analysis of the Visegrad Four countries allowed *Kovalskaya, Kovarnik, & Khamplova* (*2018*) to establish different significance but the leading role of innovative factors for macroeconomic dynamics and global competitiveness of countries. *Bochkova* (*2013*) considers R&D funding in the Visegrad Four countries to be a leading factor in the competitiveness of the countries of the region. *Kapik, & Drahokoupil* (*2011*) assess FDI in the business services sector as a factor in building the "knowledge economy" of the countries of the region.

The results of an empirical study by *Šebová, & Houdes* (*2012*) point to the close interaction of the knowledge sphere and the ICT sphere in the region of Eastern Slovakia. The authors emphasize the importance of local and translocal interaction in the region and the country, the role of social capital and the existing potential for clustering.

In order to determine the formation factors of the comparative or competitive advantages of the V4 countries, we have constructed models of the linear dependence of the Balass indices for 2004-2017 from the factors listed above. The obtained coefficients of determination are given in *Table 2*.

Table 2

Results of the analysis of the dependence of the RCA index on selected factors for the formation of competitive advantages in ICT services *

Factor	Determination coefficient R^2			
	Czech Republic	Hungary	Poland	Slovakia
R&D expenses of companies	0,51	0,33	0,80	0,64
Public spending on research and development	0,52	0,08	0,86	0,53
Foreign financing of research and development	0,32	0,58	0,56	0,16
Headcount in R&D	0,52	0,39	0,58	0,74
Salary in ICT	0,46	0,10	0,60	0,19

*Source: calculated by the authors based on data *(Eurostat, 2019)*.

It should be noted that the equation of dependence on Czech foreign financing and on the number of employed and wages in Poland received an average approximation error $\bar{A} > 15\%$ (Table 4), which indicates unsatisfactory accuracy of the models. All other equations obtained have a low approximation error, that is, they provide high prediction accuracy and are suitable for use.

To check all the constructed models, one should use the table value of the Fisher criterion F_table = F ((0.05, 1, 12)) = 4.75. The actual values of the Fisher test for each model are given in *Table 3*. Based on the results of the audit, it was found that only models of the dependence on R&D costs at the expense of companies own funds and the number of research personnel are adequate for all four countries with a significance level of α = 0.05. Models of dependence on state funding turned out to be adequate for all V4 countries except Hungary, and on foreign financing for all but Slovakia. Among salary dependence models, only Czech Republic and Poland regression passed the Fisher test.

Table 3

Average approximation errors (A) and actual values of the Fisher test (F) for dependency models

Factor	Czech Republic		Hungary		Poland		Slovakia	
	A, %	F	A, %	F	A, %	F	A, %	F
R&D expenses of companies	12,9	12,5	8,7	5,9	12,8	47,6	8,3	21,8
Government R&D expenditures	13,6	12,9	10,0	1,1	8,6	73,3	9,2	13,3
Foreign R&D funding	15,5	5,7	6,2	16,3	13,8	15,5	13,4	2,3
Headcount in R&D	12,0	13,1	8,1	7,8	18,7	16,7	6,8	34,3
Salary in ICT	14,2	10,2	10,2	1,3	16,5	17,7	13,7	2,9

*Source: calculated by the authors based on data *(Eurostat, 2019)*.

The resulting determination coefficients differ significantly in the countries of the group. Thus, models of the dependence of the Balass indices on R&D costs of enterprises at their own expense showed a close relationship in all four countries, except Hungary (moderate connection at R ^ 2 = 0.33). Indeed, in the structure of the total expenditures of the V4 countries on R&D, the funds of enterprises are the main source of financing (*Table* 4). Nevertheless, the obtained coefficients of determination show that in all four countries, except Slovakia, investment from other sources influenced the formation of the competitive advantages of ICT services to a greater extent. This can be explained by the fact that most of the expenses of private companies were directed to innovations in industry, while the high-tech services sector accounted for less than 20% of total R&D investments (*Eurostat, 2019*).

Table 4

the Structure of the spending of countries V4 on research and development by sources of funding in 2017*

Country	Enterprises		State budget		Foreign sources	
	expenses, million euros	In % of total expenses	expenses, million euros	In % of total expenses	expenses, million euros	In % of total expenses
Czech Republic	1 350,0	39,8	1 186,4	34,9	858,7	25,3
Hungary	881,3	53,0	533,6	32,1	248,9	15,0
Poland	2 539,9	54,3	1 850,5	39,6	287,8	6,2
Slovakia	367,2	49,9	265,9	36,1	102,9	14,0
V4 together	5 138,4	0,49	3 836,4	0,37	1 498,2	0,14

*Source: foldable by authors based on data *(Eurostat, 2019)*.

The relationship between comparative advantage and government spending on R&D was dense in all four countries except Hungary. At the same time, the Polish model (R ^ 2 = 0.86) has the highest determination coefficient, for which public investment in R&D is a strong factor in the development of the competitive advantages of the ICT sector. It should be noted that, in absolute terms, the Polish budget spends significantly more funds on research and development than in other countries - about 18.5 billion euros in 2017. Compared with 1,920,000,000 in the Czech Republic (*Table* 4). In Poland and Slovakia, a significant part of the targeted state support is aimed specifically at the formation of regional IT clusters, the main task of which is to ensure the competitiveness of computer services through the cooperation of education and entrepreneurship (*European Commission, 2020b*).

Models of the dependence of the Balass indices on foreign R&D funding showed a strong dependence (0.5 <R ^ 2 <1) in Hungary and Poland. In absolute terms, the Czech Republic received significantly more investment in R&D from foreign sources than the other four countries - more than 858 million euros in 2017 (*Table* 4). Nevertheless, the obtained coefficients of determination indicate that foreign financing has had the greatest impact on the competitive advantages of ICT services in Hungary, where foreign enterprises and TNC units dominate. According to estimates by the Hungarian Central Statistical Office, about 78% of total research and development costs and 60% of research staff costs are provided by international companies, their units, and joint ventures (*European Commission, 2020b*).

Models of the dependence on the number of personnel employed in R&D showed a strong dependence of all four countries (0.5 <R ^ 2 <1), except Hungary (moderate dependence - 0.25 <R ^ 2 <0.5). Over the years of EU membership, all four countries showed an increase in the number of researchers, Poland showed the greatest growth - almost 1.9 times (*Table* 5). However, compared to other EU countries, the number of people employed in science and technology in V4 countries remains low. In particular, in 2017, IT companies in the Czech Republic, Poland, and Slovakia reported a shortage of specialists from the latest digital and information technologies in general (European Commission, 2020b). But in Hungary, the share of IT graduates is quite high (4.3% versus 3.5% on average in the EU), and the share of IT professionals in the total structure of employees corresponds to the EU average (3.6%) (*European Commission, 2018b*).

Table 5

Comparison of the number of people employed in R&D in V4 countries in 2004 and 2017, thousand people*

Year	Czech Republic	Hungary	Poland	Slovakia
The number of employees in research and development				
2004	60,15	49,62	127,36	22,22
2017	107,73	60,93	239,28	33,47
Growth Rate	1,79	1,23	1,88	1,51
The average monthly salary of employees				
2004	831	858	778	658
2017	1640	1281	1208	1403
Growth Rate	1,97	1,49	1,55	2,13

*Source: foldable by authors based on data *(Eurostat, 2019)*.

The relationship between the average level of wages and competitive advantages was found only in the Czech Republic (moderate connection - 0.25 <R ^ 2 <0.5) and Poland (close connection - 0.5 <R ^ 2 <1). It should be noted that in both countries the relationship between the coefficients of comparative advantages and the level of wages was direct. Although an increase

in salaries leads to an increase in the cost of services provided, the comparative advantage indices also increased (*Table 5*). That is, it cannot be considered that in relation to cheaper labor costs have formed the competitive advantages of the V4 countries in the European ICT services market.

The complex of ICT services includes three categories: telecommunication, computer and information services. To determine the groups of services for which V4 countries have competitive advantages in the European market, we calculated the Balassa indices (*Table 6*). According to the calculations, it was determined that V4 countries have competitive advantages only in the provision of computer services (RCA = 1.01> 1). According to the Eurostat economic activity classifier (NACERev. 2), the category of computer services includes software development services, as well as maintenance and advice on computer equipment. The highest Balass coefficient in this category was shown by the Czech Republic (RCA = 1.24).

Table 6

Indices of the revealed comparative advantages of V4 countries in certain segments of the EU ICT services market in 2017*

Type of service	RCA	Intra-industry trade level, million Euro	ntra-industry trade intensity, %
Telecommunication services	0,81	2353,8	99
Computer services	1,01	7982,2	77
Information services	0,80	789,6	99

*Source: calculated by the authors based on data *(Eurostat, 2019)*.

We also calculated indicators of the level and intensity of intra-industry trade in ICT services of V4 countries with the EU. According to the results of calculations, a high level of intra-industry trade is observed in the provision of computer services, and the highest intensity is in telecommunication and information services (*Table 6*).

Although the level of intra-industry trade of the four countries with computer services in the EU is quite high, the intensity indicator is lower than for other services or, for example, for agricultural products (Dzyad, Krasnikova & Hrechyn, 2019). This is because of the fact V4 countries export much more computer services to EU countries than they import (more than 1.6 times).

Based on the results obtained, it can be concluded that increasing the competitive advantages of the four countries in the European ICT services market depends primarily on the ability of national computer service providers to develop and implement innovations. It should be noted that today the vast majority of V4 countries' investments in R&D are concentrated in industry. Innovation spending in ICTs is less than 15% of total R&D spending of companies in the four countries (*Table 7*).

Table 7

Expenditures of the ICT complex for R&D, 2017*

Indicator	Czech Republic	Hungary	Poland	Slovakia
R&D expenses of the ICT complex, million euros	197,11	60,19	382,00	49,43
Share of ICT in R&D expenses of companies,%	14,6	6,83	15,04	13,46

*Source: calculated by the authors based on data *(Eurostat, 2019)*.

The calculations show the potential for the development of ICT services in the four countries, especially computer services. The reorientation of the research activities of the V4 countries from the needs of industry to the development of ICT services would allow them to be competitive in the European computer services market and export products with a greater share of added value than the current leading export positions - automobiles and cars.

Among the four countries, the Czech Republic, which is one of the five European countries with the largest share of small and medium-sized businesses that provide services or sell goods online (23%) and the largest share of e-commerce in the total turnover of SMEs, should receive the greatest benefits from building a common digital market (18%). However, the lack of IT specialists (which 79% of Czech IT companies reported on) and small volumes of venture financing (less than 1% of GDP, one of the lowest rates in the EU) remain problematic issues (*European Commission, 2018b*).

In this context, the "National Strategy for the Development of the Capital Market" provides for the financing of 20,000 innovative projects in 2020-2050 for a total of 315 billion euros. According to the government program "Czech Republic - the country of the future", by 2030 the country should become a world leader in the field of artificial intelligence. Already today, funding for AI research centers in Prague and Brno exceeds € 250 million; 40% of the total number of industrial robots in the V4 countries work in the Czech Republic. Automation of the Czech industry has doubled the potential economic growth rate to 4% in 2033.

On the other hand, according to government estimates, the implementation of the latest technologies, especially artificial intelligence and automation of production, can crowd out the labor of 3,400,000 Czech workers by 2050 (*European Commission, 2018b*).

The share of the Hungarian ICT sector in the country's GDP is over 5% - the best indicator among the four countries, and the 7th best among the EU countries (*European Commission, 2019*).

In terms of venture investment levels, Hungary also ranks first in V4 with an indicator of almost 6% of GDP (*Eurostat, 2019*). However, 55% of Hungarian companies show very low levels of digitalization, and less than 15% use advanced IT technologies, including cloud and big data (the lowest among the four countries). A shortage of IT professionals is also a characteristic feature of the Hungarian labor market - 75% of IT companies report a lack of staff (*European Commission, 2018b*). In order to meet the demand for qualified personnel in the country, the Hungarian Academy of Sciences has programs to support young researchers (total budget of 14.5 million euros) and a program for the return of emigrant scientists (18.1 million euros). At the same time, the dominant share of investment in innovation (70%) is provided by foreign companies and EU structural funds, while state funding for R&D remains at the level of 2008 (*European Commission, 2019*).

Poland is the largest provider of ICT services among V4 in absolute terms, and ranks ninth among the EU countries (*European Commission, 2019*).

However, only 4% of Polish enterprises export goods or services online, and less than 10% use the latest technology. About a third of Polish companies say that low levels of digitalization are due to the low share of graduates in IT specialties (3.1% compared to 3.5% on average in the EU). Although private investment in R&D has more than quadrupled during EU membership, the growth rate of patent applications and high-tech exports remains moderate (*European Commission, 2018b*).

The "Operational Program for Building Digital Poland" should provide training for specialists in cybersecurity, artificial

intelligence, big data, etc. in 2021-2027, and launched in 2019. Lukashevich's research network will become a platform for cooperation between science and business, especially SMEs.

In Slovakia, research and innovation depends heavily on ESF funding (39%), while the level of business spending on R&D remains one of the lowest in Europe (0.45% of GDP) (*European Commission, 2020b*). As a result, Slovakia is inferior to all V4 countries in the number of high-tech patent applications. To stimulate business investment in 2018 alone, 72 million euros of tax credit were compensated to companies that carried out R&D. To improve the digitalization of the economy (only 13% of companies use the latest technology), the "Slovakia 2030 Digital Transformation Strategy" has been developed, which provides for the creation of regional IT clusters in Bratislava and Zhylin, as well as the creation of the National Center for Artificial Intelligence Research. Slovakia, like the Czech Republic, is one of the world leaders in industrial automation. According to the estimates of Slovak scientists, the deepening of production robotics can change or completely eliminate up to 64% of jobs in Slovakia (*European Commission, 2018b*).

5. Conclusions

The analysis showed that in the Czech Republic and Slovakia the existing ones are competitive, and in Hungary and Poland they have comparative advantages in the EU ICT services market. Ensuring four freedoms, implementing a European competition policy, national efforts on research, innovation, investment and competitiveness in the V4 countries led to an increase in export specialization, which indicates a relatively high integration and effectiveness of competitive advantage management in the Czech Republic, moderate in Poland and Slovakia low - in Hungary. Countries have demonstrated competitive advantage primarily in the computer services segment. According to the results of the regression analysis, it was found that the main factors in the formation of the competitive advantages of the V4 countries in the European ICT services market were investments in development, innovation and R&D. At the same time, in Slovakia the greatest impact was played by companies' investments in research and development, in Hungary - foreign financing of research and development, and in the Czech Republic and Poland - state. Another significant factor was the increase in the total number of specialists involved in R&D.

Building a common digital market will increase competitive pressure on the IT companies of the four countries that will compete with the largest European suppliers (Germany, France, Italy, Spain, Ireland) not only in international but also in national markets. In addition, the latest technology and automation of production require the reorientation of millions of workers in industry to work in the service sector, including in ICT. Therefore, in order to realize the competitive advantages in the European market of ICT services and to benefit from the joint digital market, the V4 countries should: ensure the training of specialized personnel of sufficient quantity and quality; Encourage private investment in R&D and business cooperation with science and education through tax and administrative incentives; promote the digitalization of national economies, especially SMEs.

The practical value lies in the generalized experience of the Visegrad four countries and in determining the factors, directions and priorities of the national policy for the development of the ICT sector in the transition to the digital economy.

Prospects for further research are related to the assessment of socio-economic changes in labor markets under the influence of digitalization.

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The authors declare that they have no competing interests.

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Appendices

A – Estimated data for regression models

Table A.1

Estimated data for regression models, 2004-2010*

Country	Indicator	2004	2005	2006	2007	2008	2009	2010
Czech Republic	RCA	0,3995	0,8085	1,1083	0,9818	0,8619	1,0145	0,8323
	Expenses of companies, million euros	581,05	617,30	749,20	849,67	900,64	765,11	854,17
	Government spending, million euros	460,79	579,15	686,09	805,37	895,62	919,27	930,98
	Overseas. financing, million euros	40,67	69,08	72,74	130,82	177,63	217,00	291,74
	Headcount	60148	65379	69162	73081	74508	75788	77903
	Salary in ICT, Euro	831	964	1076	1451	1426	1385	1469
Hungary	RCA	0,7967	0,7799	0,8749	0,9015	0,9242	0,9879	0,915
	Expenses of companies, million euros	267,63	330,39	389,92	428,76	511,64	495,46	533,46
	Government spending, million euros	373,71	413,89	403,16	434,12	442,93	448,02	442,97
	Overseas. financing, million euros	74,67	89,38	101,71	108,35	98,22	116,36	139,11
	Headcount	49615	49723	50411	49485	50279	52522	53991
	Salary in ICT, Euro	858	962	954	1129	1125	1053	1045
Poland	RCA	0,4069	0,3418	0,4292	0,4678	0,4776	0,5485	0,6426
	Expenses of companies, million euros	347,11	462,12	499,94	604,17	668,32	567,87	636,62
	Government spending, million euros	702,22	799,68	869,02	1033,6	1311,95	1266,82	1588,88
	Overseas. financing, million euros	58,72	79,59	106,42	118,48	118,90	115,21	308,16
	Headcount	127356	123431	121283	121623	119682	120923	129792
	Salary in ICT, Euro	778	876	980	1024	1174	959	1078
Slovakia	RCA	0,6930	0,6286	0,9173	0,7781	0,7607	0,8255	0,8673
	Expenses of companies, million euros	66,64	71,14	75,70	89,74	105,77	106,38	145,98
	Government spending, million euros	99,39	110,85	120,33	135,93	159,60	153,20	206,4
	Overseas. financing, million euros	7,47	11,74	19,60	25,81	37,48	38,72	61,06
	Headcount	22217	22294	23120	23437	23641	25388	28128
	Salary in ICT, Euro	658	738	824	987	1396	1757	1284

*Source: foldable by authors based on data (*Eurostat, 2019*).

Table A.2

Estimated data for regression models, 2011-2017*

Country	Indicator	2011	2012	2013	2014	2015	2016	2017
Czech Republic	RCA	0,9365	0,9521	0,9816	1,0705	1,0783	1,1387	1,1997
	Expenses of companies, million euros	961,68	1046,88	1126,60	1110,37	1122,17	1171,68	1350,04
	Government spending, million euros	1064,6	1058,3	1041,0	1018,1	1047,0	1055,5	1186,37
	Overseas. financing, million euros	501,65	745,88	813,65	942,01	1056,3	710,52	858,66
	Headcount	82283	87528	92714	97353	100128	99875	107734
	Salary in ICT, Euro	1549	1550	1497	1455	1501	1531	1640
Hungary	RCA	0,7941	0,7302	0,6915	0,7012	0,6784	0,6833	0,7367
	Expenses of companies, million euros	571,74	589,47	662,29	689,88	751,19	773,99	881,31
	Government spending, million euros	458,94	463,54	507,73	478,45	523,15	360,00	533,57
	Overseas. financing, million euros	162,03	193,61	234,47	250,63	225,90	227,48	248,87
	Headcount	55386	56486	58237	57185	56235	54636	60932
	Salary in ICT, Euro	1089	1080	1136	1104	1135	1170	1281
Poland	RCA	0,7142	0,7100	0,7092	0,7845	0,8500	0,8701	0,8997
	Expenses of companies, million euros	797,41	1107,99	1282,74	1506,82	1683,64	2183,81	2539,86
	Government spending, million euros	1582,66	1760,58	1623,47	1747,06	1805,34	1598,07	1850,53
	Overseas. financing, million euros	379,80	457,84	450,77	516,38	722,69	224,86	287,79
	Headcount	134551	139653	145635	153475	157921	171610	239283
	Salary in ICT, Euro	1115	1086	1105	1113	1153	1133	1208
Slovakia	RCA	0,9737	0,9354	0,7372	0,9883	0,9855	1,0952	1,2753
	Expenses of companies, million euros	158,58	220,66	245,54	215,72	232,35	296,21	367,22
	Government spending, million euros	233,06	243,30	237,62	277,11	296,13	262,67	265,91
	Overseas. financing, million euros	66,33	109,15	109,75	158,57	365,64	68,61	102,91
	Headcount	28596	28880	27823	28825	28752	33252	33467
	Salary in ICT, Euro	1353	1416	1387	1324	1325	1337	1403

*Source: foldable by authors based on data (*Eurostat*, 2019).

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Types and terminology of remote project teams

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Purpose – to develop project management terminology.

Findings. This study indicates the significant changes that occurred in working conditions in the last centuries that led to the new models' formation of employee interaction at enterprises, especially remotely, such as distributed, virtual, and dispersed project teams. Clarification of the terminology of project management indicates the meaning of the term "distributed team". This paper separated the term from several related concepts and demonstrated the benefits of integrating distributed project teams within an enterprise.

Originality/Value. Paper analyzes the term, features and differences of the distributed project team from other types of remote teams.

Practical implications. The terminology of remote project team can be used by project managers from a theoretical point of view.

Research limitations/Future research. Future research can focus on the way to manage a distributed project team effectively.

Paper type – theoretical.

Keywords: project management; project team; distributed project team; collocated project team; virtual project team; dispersed project team.

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Види і термінологія віддалених проектних команд

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Мета роботи – розвити термінологію управління проектами.

Результати дослідження. Це дослідження вказує на значні зміни, що відбулися в умовах праці в останні століття, що призвели до формування нових моделей взаємодії співробітників на підприємствах, особливо віддалених, таких як віддалені, віртуальні та розпорошені команди проектів. Уточненою термінологією управління проектами вказано на значення терміну «розпорошена команда». У цій роботі цей термін виокремлено від кількох суміжних концепцій та продемонстрано переваги інтеграції розподілених проектних команд у межах підприємства.

Оригінальність/Цінність/Наукова новизна дослідження. Проаналізовано термінологію, особливості та відмінності віддаленої команди проекту від інших типів віддалених команд.

Практичне значення дослідження. Термінологія віддаленої команди проектів може використовуватися менеджерами проектів з теоретичної точки зору.

Обмеження дослідження/Перспективи подальших досліджень. Майбутні дослідження можуть зосередитись на способі ефективного управління віддаленою проектною командою.

Тип статті – теоретичний.

Ключові слова: управління проектами; проектна група; розподілена команда проекту; класична команда проекту; віртуальна команда; розпорошена команда проекту.

Виды и терминология удаленных проектных команд

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Цель работы – развить терминологию управления проектами.

Результаты исследования. Выявлены существенные изменения, произошедшие в условиях труда за последние столетия, которые привели к формированию новых моделей взаимодействия сотрудников на предприятиях, особенно удаленно, таких как удаленные, виртуальные и рассредоточенные проектные команды. Уточненная терминология управления проектами указывает на значение термина «распределенная команда». В этом документе этот термин отделен от нескольких связанных понятий и продемонстрированы преимущества интеграции распределенных проектных групп в рамках предприятия.

Оригинальность/Ценность/Научная новизна исследования. Проанализированы терминология, особенности и отличия удаленной проектной группы от других типов удаленных команд.

Практическое значение исследования. Термин удаленная проектная группа может использоваться менеджерами проектов с теоретической точки зрения.

Ограничения исследования/Перспективы дальнейших исследований. Дальнейшие исследования могут быть сосредоточены на способах эффективного управления удаленной проектной командой.

Тип статьи – теоретический.

Ключевые слова: управление проектами; проектная группа; разделенная проектная команда; совместная проектная команда; виртуальная проектная команда; удаленная команда проекта.

1. Introduction

While practicing project managers, we observed numerous terminological confusions to classify their teams based on their remote work organization. Today, the difference between one form of the project team and another requires speaking the same language with business stakeholders and project managers in the scientific community. Recognizing the emergence of distributed project teams at the enterprise is essential today during the pandemic that motivated us to develop the article. The investigation way of this paper allows identifying areas that were not sufficiently considered in previous papers. This paper also helps to determine the main advantages of the distributed project teams.

2. Theoretical background

As the work organization format in teams is popular within the corporate system, the number of studies that examine team concepts increased (*Kozlowski & Bell, 2016*).

Many scholars reflected distributed teams in project management processes during the last century. In particular, researchers (*Harrison, Wheeler & Whitehead 2003*) focused on the digital revolution and the technologies that gave the virtual space for interaction among employees in distributed project teams, which are indefinite without excessive resource consumption. Another scientist (*Glebov, 2010*) focuses on international relations development and its impacts on global organizations. Available literature extensively focuses on the correlation between distributed project team productivity and the geographical distance among team members (*Zibratt, Hoegel, 2009*). Some authors (*Bergel, Balsmer, 2008; Gajendran, Harrison & Delaney, Klinger, 2015; Berntzen & Wong, 2019*) suggest using digital communication tools between team members and other processes for significant interaction in distributed project teams. Simultaneously, according to Schulze, companies should consider the challenges distributed teams face to mitigate technology (*Schulze, 2017*).

With a wide range of communication channels possible, distributed teams are becoming increasingly popular in small and large organizations (*Eubanks et al., 2016; Noroozi, 2018*). Other favorite terms for the remote work environment are virtual, scattered, or dispersed work organization types in the projects (*Makarius & Larson, 2017*). Authors assume that virtual teams are not about the distance among team members and the organizations, but more about the team's function (*Liao, 2017*). In terms of disadvantages still, we see that authors see risks behind such a work organization from the publications. Virtuality on a team does give the leader, organization, and team mobility, which still encourages interpersonal challenges as social contact decreases (*Hoch & Kozlowski, 2014*). The mentioned difficulty is also supported by the fact that virtual teams work in different time zones regularly, resulting in synchronization problems (*Rutkowski et al., 2007*). Fixing requires that modern team communication be more predictable, while regular time slots for team members' meetings should be set well in advance (*Gilson et al., 2015*). Another opinion on how to solve these communication issues in virtual teams is that this challenge is resolvable when the organization deploys the correct software tools and provides its staff members with the proper training (*Wildman & Griffith, 2015*).

There is an opinion on differences among team types that, unlike virtual, scattered teams or co-located teams of permanently placed team members in central locations (centers), distributed teams only positions the team leader in a central (*Bos, Shami, Olson, Cheshin & Nan, 2004*).

Nowadays, it becomes very typical for teams to be spread geographically and use communication tools (*Zaveri, 2020*). The recent studies are based on the abundance of reliable analysis and relevant corporate team knowledge (*Day, Fleenor, Atwater, Sturm & McKee, 2014*).

Despite the relatively large number of papers on this issue, the relevance of the further research of the new organizational structures formation to maintain a high level of project management efficiency still stands. Consequently, the existing developed practical tools require scientifically reliable and verified project management theories, which define the study's purpose and primary objectives.

3. Problem statement

This article aims to identify and summarize the typical vital features of a distributed project team based on secondary data and literature review analysis.

4. Methods and data

The literature review describes the key features of the globalization period in more detail, how technology has affected the global market, and organizational principles that resulted in the new form of project organization via distributed project teams. Secondary data from employment, skills, education, and technologies are further elaborated on in the results section. The chosen method consisted of the three main steps: (1) Collection of studies; (2) Selection of the proper ones; (3) Key points assuming.

Various sources and databases such as Google Scholar, Springer, ProQuest, ScienceDirect served as sources for summarizing the literature and secondary data. The literature review was performed on the basis of the top-ranked journals and articles using the Boolean search operators and the Google Scholar database and searching articles in incognito mode for more reliable results. We relied on the sources above for its provision with the most significant worldwide library of business information, and the sources could be filtered by reputation and quoting rate in various areas. Besides, we applied the advanced search logic to obtain more precise results via browsing this review's main keywords. Our structured literature review includes beneficial recommendations for future research and is also relevant for a practical perspective. Our literature review results are especially relevant for project managers to use the correct terminology to mainly influence stakeholders' reactions and, thus, the company's reputation.

5. Results and Discussion

Active development and introduction of modern technologies, globalization, changes in the system of needs, and many other factors have led to the significant expansion of the companies' and organizations' capabilities. As for today, the employees of a company can live in different cities or even countries, speak various languages, and belong to different cultures but still work in one corporate environment (*Paul, 2016*).

Nevertheless, it was not always the case, as at the beginning of the 19th century, the specialists did not work remotely, and the employees' workplace in the office building was employment's mandatory attribute. In the mid-1900s, organizations' development strategy shifted to a single and controlled space to ensure maximum productivity of human and production units (*Harrison, 2003*). In the 1960s, office space worked as a communications environment where business executives tried to streamline the information flow between employees and remove physical barriers among colleagues. In the 1980s, the workplace's understanding changed towards the computerization around the world, when computers evolved and became more accessible. Computers and the digitalization era have begun to organize office workplaces in a new manner to optimize specialists' actions and transform information from written sources to digital format.

At the beginning of the 1990s, the introduction of "new ways of work" in response to the awareness that technology transforms cultural, social, technological, and construction processes worldwide (*ECATT Final Report, 2000*) caused the second phase the

office space change. Meantime, the virtual world and digital instruments reduced office employees' need in synchronous, direct communication, and work in a single location to perform specific tasks. Today, the global economy features the increasing virtualization of products, processes, organizations, and relationships. New production in the economy no longer requires people to work together in the same physical space to gain access to the tools and resources they need for productive activity. Simultaneously, it allows them to distribute work among employees (*Harrison, Wheeler, 2003*).

Globalization is another trend in the modern world. The "globalization" term is widely popular and determined in various ways (*Hoegl, Proserpio, 2007*). From "the process of global economic, political, cultural and religious integration and unification" to "the current trend that applies to organizations crossing economic and geographical boundaries and changes the regional perspective to global" (*Glebov, 2010; Bhagwati, 2004*). Globalization is also described as a feeling that the world is getting smaller, while the world economy is becoming wider (*Friedman, 2005*). According to M. Friedman, organizations can connect different societies, geographic regions to achieve business objectives and search for opportunities to benefit from. Over the past decades, this process has accelerated, as technology contributed to information and knowledge flows, and led to the search for human resources irrespectively to the geography. Many authors agree that modern times' technological progress accelerated human ability to interact as a global society in different aspects and contributed explicitly to achieving business goals (*Friedman, 2005; Martinelli, Waddell, 2010*).

The following factors (*Priklandnicki, Audy, Evarito, 2006*) shifted the massive investments from local to global markets on the point of creating new cooperation forms:

– raising awareness of the benefits of doing business around the world, including customer knowledge and local conditions;
– shorten project timelines and reduced time to enter the product market due to time differences in different time zones;
– availability of a global base of the qualified resources on a global scale for the products development at different prices (*Herbsleb, Moitra, 2001*);
– investment allocation by region also minimizes risks in natural, economic, and other disasters (*Lehtonen, 2009*).

To support key strategic initiatives in global trends such as globalization, outsourcing, and strategic partnerships, organizations increasingly turn to geographically dispersed groups that rely on technology and digital communication tools for distributed project team members.

However, before discovering the benefits of such a team, in our perception, it is worth defining the terminology, as there are several similar concepts in papers and project management practice (*Table 1*).

Table 1

Analysis of the project teams types*

Term	Definition	Examples
Co-located (traditional) team	Team members are working at one physical location with an ability to collaborate and communicate with each other face to face.	Production and manufacturing institutions as well as aviation companies or IT such as Yahoo, IBM
Distributed team	A cross-functional team, i.e., working at geographically distributed offices worldwide and interacting with each other using digital software tools to carry out the project tasks.	Companies like Trello, Basecamp, InVision, Zapier
Virtual team	A group of geographically distributed employees who deal with at least one task supported by information and communication technologies without physical offices (*Hoegl, Proserpio, 2001*)	Companies like GitLab, Automattic, Clevertech, FlexJobs
Scattered or Dispersed team	A project team of geographically distributed members is not a cross-functional team, most of whom work in the headquarters and interact with information technology for project tasks.	The companies like eBay, SAP, Yandex, Elastic, Volvo

*Source: Authors' elaboration based on their theoretical generalizations.

According to the previous table's theoretical study, they identified types of teams similar in terms of belonging to one project team but differed in their location and use of certain information and communication technologies. Also, dispersed team is very similar to a dispersed team, so further, we consider the features by which their differentiation becomes more understandable. For example, if the project has cross-functional teams in Kyiv, Chicago, San Francisco, and Bangalore, this can be called a project with four distributed teams. If the project includes four teams, each of which includes two developers from Kyiv, a manager from San Francisco, an analyst from Chicago, and a test engineer from Bangalore, these teams are not cross-functional since they can not be replaced one by another.

In this regard, the «distributed team» term, which the author defines in *Table 1*, will be further used in this study.

In general, distributed teams have many potential benefits (*O'Duinn, 2018*), the main of which, in our opinion, are:

– the development of world markets. With the expansion of business, organizations have the opportunity to gain experience in new markets through mergers/acquisitions or the creation of affiliated companies located in such markets;
– the world's talent base. Increasingly, companies are looking for highly skilled personnel outside the home country. The working visa, travel expenses coverage, and new employees willingness to make the business travels - are the prerequisites that company managers must find out at the stage of formation of a distributed team;
– the costs reduce. Companies often seek to cut down the costs by attracting external suppliers to regions with fewer overheads. For example, an outsourced service provider may represent an obvious cost savings of 25% compared to a domestic supplier. However, although individual team members' hourly costs may be lower, the reduced productivity and additional travel costs may offset the expected savings from attracting employees from other regions. Therefore, it is crucial to consider such a risk and reasonably decide to build a distributed team.

In the early 2000s, several researchers (*Bergiel, 2008; LaBrosse, 2008; Shachafa, 2008; Kuropuarchichi, 2009; Siebdrat, Hoegl, Ernst, 2009; Vasudev, 2010; Karia, 2016; McNeese, 2020*) consider the benefits determination of distributed teams. The summary of the distributed team advantages considered by the authors depicts *Table 2.*

Table 2

Main advantages of distributed teams in the papers 2008-2020*

#	Benefits	Authors							
		Bergel	LaBrosse	Shachafa	Kuropuarchichi	Siebdrat	Vasudev	Karia	McNeese
1	Reducing operating costs	yes	yes		yes	yes	yes		yes
2	Using the world talent base	yes	yes	yes	yes	yes	yes		yes
3	The flexibility of the talents search		yes		yes			yes	
4	Increase in productivity		yes		yes			yes	
5	Variety of personnel	yes	yes		yes	yes			yes
6	Reducing travel expenses	yes	yes		yes	yes			
7	Optimize the project life cycle			yes	yes	yes	yes		yes
8	Livelihood level increase				yes				yes
9	Reducing the environmental impact		yes				yes	yes	
10	Improving business strengths	yes	yes		yes	yes		yes	

*Source: Authors' elaboration based on (*Bergiel, 2008; LaBrosse, 2008; Shachafa, 2008; Kuropuarchichi, 2009; Siebdrat, Hoegl, Ernst, 2009; Vasudev, 2010; Karia, 2016; McNeese, 2020*).

The revealed benefits indicate that distributed teams have vital differences from the collocated teams. Firstly, other teams or be the members of another organization engage team members in the same way as the team members of collocated teams. Secondly, distributed teams, unlike collocated teams, are constantly changing, so the membership in such teams is not permanent. Thirdly, the distributed teams are defined by a complex structure of subordination caused by team members' distributedness from each other and time difference.The main features that distinguish the distributed teams from the collocated teams have become scientific research of the authors (*Zigurs, 2003; Curseu, Schal, Wessel, 2008; Schlenkirch, 2009; Ahuja, 2010; Fovler, 2015*). We made the systematization of available copyright approaches in *Table 3*.

Table 3

Comparative analysis of the collocated and distributed teams in the papers dated 2003 – 2015*

#	Comparison Criteria	Authors				
		Zigurs	Curseu	Schlenkirch	Ahuja	Fovler
1	Collocated / Distributed groups	yes	yes	yes	yes	yes
2	One on one / Virtual Collaboration	yes	yes	yes	yes	yes
3	Different / Same Goals		yes	yes		
4	Different / Same time			yes	yes	
5	Different / Same Culture			yes	yes	
6	Various / Same organization			yes	yes	yes
7	One / Several teams			yes		yes
8	Specialized / Multifunctional team			yes		yes
9	Static / Flexible team			yes	yes	yes

*Source: Authors' elaboration based on the (*Zigurs, 2003; Curseu, Schal, Wessel, 2008; Schlenkirch, 2009; Ahuja, 2010; Fovler, 2015*).

According to *Table* 2 and *Table* 3, the difference between collocated and distributed teams is significant. Therefore, there is considerable discussion in the scientific world to find the answer to the question under which conditions it is necessary to use the team's collocated or distributed model. The papers of (*Mendoc, 2007; Thomas, 2008; Webster, 2008*) highlight attempts to determine such conditions. The mentioned scholars consider the following main requirements when making the decision:

– The team's size is essential (regardless of whether the team is collocated or distributed). Smaller teams work better than larger teams across various aspects, including trust, productivity, and knowledge sharing.
– The management scale matters - the teams' distribution should be based on team members' self-organization and their ability to build relationships distributedly and manage work alone. Thus, skilled management is more critical in distributed teams than in collocated ones.
– Social and team spirit is vital for the work performance - the team identity sense formation, trust in one another, and social development affect the atmosphere of both a distributed and collocated team. Part of this factor is related to the management style.
– The technical aspect of communication support is vital for the distributed teams; therefore, all team members must have excellent skills in their application (and the communication tools must be useful and reliable). Such interactions are possible via shared platforms, webchats, SMS, phone, and the like. One-to-one collaboration is considered to be a more straightforward form of communication, since, under these conditions, there will be subtle non-verbal signals.

Researchers have not found yet the fundamental difference between collocated and distributed teams regarding other factors, such as productivity, quality, and performance.

6. Conclusion

Consequently, the economic, legal, political, and cultural labor landscape changes (*Thomas, 2008*), leading to an increase in employees' geographical distribution and all the inherent complexities, are still relatively new to modern organizations. That leads to the distributed organizational forms of cross-functional interaction, where geographically distant employees use modern communication technologies and perform everyday tasks. Nevertheless, understanding the content, purpose, and benefits of the distributed teams are not enough to ensure their effective implementation.

When doing the literature review in this paper, we developed terminology to name different work organizations according to remote working methods, such as distributed team, dispersed, and virtual project team, and outlined the team's co-located type. Besides, this study highlights the advantages of distributed team integration into the corporate environment.

In our opinion, further research should relate to the substantiation of the SMART criteria for the feasibility of distributed teams in project management and methodological approaches to planning effective communication between team members.

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8. The competing interests

The authors declare that they have no competing interests.

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Social capital and internationalization of commercial banks in Kenya

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Purpose – to study sought to delve into social capital and commercial banks' internationalization in Kenya Drawing on the internationalization concept.

Design/Method/Approach. The research adopted a positivist philosophical approach and used a descriptive cross-sectional research design targeting top and middle-level managers in Kenya's commercial banks. Data was collected using a structured questionnaire and analyzed using SPSS version 22.0 for both descriptive and inferential statistics. Structural Equation Modelling was used to establish the influence of social capital on commercial banks' internationalization in Kenya.

Findings. The findings established a significant and positive relationship between the components of social capital: inter-cultural empathy, interpersonal impact and diplomacy, and commercial banks' internationalization.

Practical implications. The results have significant consequences: Firstly, social capital has a positive and statistically significant relationship with commercial banks' internationalization. Secondly, all dimensions of social capital affect the acquisition of foreign market knowledge and financial resources. Thirdly, the use of individuals' social capital often changes during internationalization.

Originality/Value. The study's novelty demonstrates the interaction of commercial banks' managers in Kenya on the application of social capital as an internationalization orientation process.

Research Limitations/Future Research. The research contributes to the advancement of location theory. It opens avenues for future research to establish what extent social capital is beneficial to banks that have ventured into international markets.

Paper type – empirical.

Keywords: social capital; internationalization; inter-cultural empathy; interpersonal impact; diplomacy.

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Соціальний капітал та інтернаціоналізація комерційних банків у Кенії

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Мета роботи – вивчити соціальний капітал та інтернаціоналізацію комерційних банків у Кенії, спираючись на концепцію інтернаціоналізації.

Дизайн/Метод/План дослідження. У дослідженні було застосовано позитивістський філософський підхід та використано описовий дизайн досліджень у поперечному перерізі, націлений на керівників вищого та середнього рівня в комерційних банках Кенії. Дані були зібрані за допомогою структурованої анкети та проаналізовані за допомогою SPSS версії 22.0 як для описової, так і для випадкової статистики. Моделювання структурних рівнянь було використано для встановлення впливу соціального капіталу на інтернаціоналізацію комерційних банків у Кенії.

Результати дослідження. Встановлено значний і позитивний взаємозв'язок між компонентами соціального капіталу: міжкультурною емпатією, міжособистісним впливом та дипломатією та інтернаціоналізацією комерційних банків.

Практичне значення дослідження. Результати мають значні наслідки: По-перше, соціальний капітал має позитивні та статистично значущі взаємозв'язки з інтернаціоналізацією комерційних банків. По-друге, всі виміри соціального капіталу впливають на придбання знань на зовнішньому ринку та фінансових ресурсів. По-третє, використання соціального капіталу індивідів часто змінюється під час інтернаціоналізації.

Оригінальність/Цінність/Наукова новизна дослідження. Новинка дослідження демонструє взаємодію менеджерів комерційних банків у Кенії щодо застосування соціального капіталу як процесу орієнтації на інтернаціоналізацію.

Обмеження досліджень/Перспективи подальших досліджень. Дослідження сприяє вдосконаленню теорії розташування. Це відкриває шляхи для майбутніх досліджень, щоб встановити, наскільки соціальний капітал вигідний банкам, які вийшли на міжнародні ринки.

Тип статті – емпіричний.

Ключові слова: соціальний капітал; інтернаціоналізація; міжкультурна емпатія; міжособистісний вплив; дипломатія.

Социальный капитал и интернационализация коммерческих банков в Кении

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Цель работы – изучить социальний капитал и интернационализацию коммерческих банков в Кении, основываясь на концепции интернационализации.

Дизайн/Метод/План исследования. Использован позитивистский философский подход и описательный кросс-секционный дизайн исследования, ориентированный на руководителей высшего и среднего звена коммерческих банков Кении. Данные были собраны с использованием структурированной анкеты и проанализированы с использованием SPSS версии 22.0 как для описательной, так и для логической статистики. Моделирование структурных уравнений использовалось для определения влияния социального капитала на интернационализацию коммерческих банков в Кении.

Результаты исследования. Результаты установили значительную и позитивную взаимосвязь между компонентами социального капитала: межкультурное сочувствие, межличностное влияние и дипломатия, а также интернационализация коммерческих банков.

Практическое значение исследования. Результаты имеют важные последствия: во-первых, социальный капитал имеет положительную и статистически значимую связь с интернационализацией коммерческих банков. Во-вторых, все измерения социального капитала влияют на приобретение знаний о зарубежных рынках и финансовых ресурсов. В-третьих, использование социального капитала людей часто меняется в процессе интернационализации.

Оригинальность/Ценность/Научная новизна исследования. Новизна исследования демонстрирует взаимодействие менеджеров коммерческих банков Кении по вопросам применения социального капитала как процесса ориентации на интернационализацию.

Ограничения исследований /Перспективы будущих исследований. Исследование способствует развитию теории локации. Это открывает возможности для будущих исследований, чтобы установить, в какой степени социальный капитал приносит пользу банкам, которые вышли на международные рынки.

Тип статьи – эмпирический.

Ключевые слова: соціальний капітал, інтернаціоналізація, міжкультурна емпатія, міжособистісний вплив, дипломатія.

1. Introduction

Global mindset enables managers to do business globally and conceive international strategies as they understand international markets and global economic trends (*Fatehi & Ghadar, 2014*). The importance of an organization's global mindset is not all about being able to do everything, but rather to understand the nuances and complexities of the global environment, the trade-offs, and opportunities as soon as they are available (*Miriam, Lisak, Harush, Glikson, Nouri, & Shokef, 2013*). The main benefit of a global mindset is its ability to associate speed with an accurate response. The drivers of internationalization not only require resources but also depend on a global mindset (*Altbach, 2015*). At an organizational level, a global mindset is essential for building trust and commitment within the business' internationalization process. However, it is based on the management's ability to enhance knowledge and communication channels between the parties involved in the network (*Mumia, 2014*).

There are three critical elements of the global mindset: intellectual capital, psychological capital, and social capital (*Maike & Franziska, 2017*). However, the focus of this paper is on social capital. Social capital involves the internal and external relationships of a firm, and how individuals can be assured of benefits from being members in social systems (*Abd et al., 2014*). Social capital consists of structural social capital, relational social capital, and cognitive, social capital (*Marthinsen, 2015*). Structural capital is considered an asset based on the position an individual occupies in a network and the contacts the individual enjoys and provide him/her with information (*Marthinsen, 2015*). Global mindset capability requires a manager to adjust their approach in different cultural settings, identify cultural similarities, and respect cultural differences (*Ranker & Huang, 2015*).

Social capital has three primary attributes; inter-cultural empathy, interpersonal impact, and diplomacy. Inter-cultural empathy focuses on the ability of an organizational manager to connect with employees or stakeholders in an organization (*Montero, 2016*). Inter-cultural empathy is a reflection of the manager to possess the ability for local and cross-cultural interests, values, and beliefs that have variations from the national culture. It is highlighted by the manager's ability to effectively and emotionally connect with individuals across cultures using understandable non-verbal cues to create this collaboration (*Javidan & Walker, 2013*).

The focus of interpersonal impact is on the manager's capacity to create active personal and professional networks and connections that act as a competitive advantage. The focus of the interpersonal impact is on the manager's ability to possess cross-border negotiation skills (*Maike & Franziska, 2017*). Possession of such global-spanning networks reflects the ability of the manager to possess a wide range of cultural experience that creates efficiency in interactions with other employees and organizations.

Further, diplomacy entails the manager's personality-based ability to understand and be understood by others in and outside the organization (*Masila, 2019*). It reflects the ability of the manager to view with an impression of inculcating inter-cultural empathy and interpersonal impacts in the organizational setup. A manager who possesses the ability to engage in conversations, a holder of multiple points of view, is an agile listener, and can willingly collaborate portrays of high-level diplomatic capability (*Javidan & Walker, 2013*). The ability to concurrently consider local cultures and markets and global dynamics is a crucial characteristic of a global mindset. The global mindset is a knowledge structure with high differentiation and high integration (*Yuhua, 2015*). At the corporate level, a strategic global mindset is defined as the aggregated individual global mindset adjusted for the distribution of power and mutual influence among the group (*Javidan & Bowen, 2013*). The highest returns to investment in cultivating a strategic global mindset emerge from focusing on the senior management level (*Story et al., 2014*).

Bank internationalization is the process by which a bank gradually increases its international presence (*Clapp-Smith & Wernsing, 2014*). Many large banks in the world have been struggling towards a new organizational model with their home markets seemingly becoming by-products in a broader strategic vision (*Asira, 2013*). Banks go abroad to serve their domestic customers who have gone abroad (*Maike & Franziska, 2017*). The recent trend of bank internationalization is characterized by both financial institutions following their existing relationships and increasingly global banks seeking to widen their activities in the financial markets of the host country, by controlling stakes, acquisition of the majority, or the acquisition of the minority, non-controlling stakes (*Yamada, 2016*).

Increasingly, Kenya is becoming cosmopolitan to the point that there is a need to recognize that local communities are becoming global. Globalization makes the impact of the local communities more substantial. In the wake of globalization, more than cross-cultural understanding is required to participate fully in business (*Chebii, 2015*). Consequently, businesses must embrace global cultures and integrate them into consumer lives and other businesses (*Astrid, 2014*). These could be realized by embracing social capital in terms of network and the contacts to provide information. Commercial banks in Kenya are licensed and regulated by the Companies Act, the Banking Act, the Central Bank of Kenya Act, and the various prudential guidelines issued by the Central Bank of Kenya (CBK). In Kenya, there are forty commercial ones(*CBK, 2018*).

These banks have significantly increased their presence within the Eastern Africa region through foreign direct investments (*Asira, 2013*). The advancement in communication technology, the realization of the East African Community (EAC), improved infrastructure in the region, and overall globalization have also contributed towards the trend (*Conrad & Meyer, 2018*).

2. Theoretical background

2.1. Location theory

This research was grounded on the Location theory proposed by Johann Heinrich von Thunen in 1826. However, the foundation of the modern location theory is traced back to Alfred's Weber's work in 1909 (*Nickel & Puerto, 2006*). The theory is concerned with the necessity for selecting a geographical location for the sole purpose of enhancing the economic activity. The geographical location is necessary for enhancing the social aspects of an organization's interaction with the communities and the government. The theory states that organizations typically choose a location to minimize their total costs (*Harvey, 2017*). As suggested by *Brown* (*1989*), location theory makes an explanation of the reason why certain economic activities are located in particular regions and environments. Accordingly, the management of organizations selects specific locations for maximization of earnings, while at a personal level, individuals select localities based on the maximization of utilities (*McCann & Sheppard, 2003*). Organizations with a management that has the clarity of mindset of local knowledge, barriers in trade, aspects of competition, and localization of prices can influence the viability of the organization to venture into an external market (*Brown, 1989*).

In support of the location theory, *Harvey* (*2017*) suggested that the overall operations and performance of organizations such as commercial banks are highly supported by the presence of a centralized location. Centralization of the production system makes it plausible for the management of an organization to enhance coherent and orderly supervision of all the activities aimed at maximizing the production of goods and services. Further, centralization supports the organization in creating mutual relationships with communities and governments that supply labor and market (*Nickel & Puerto, 2006*). Concerning this research, location theory is relevant in anchoring social capital as an essential component of the internationalization of commercial banks.

2.2. Research question

Kenyan banks are quite sluggish in internationalization efforts, mainly due to various management challenges partly attributed to the absence of a global mindset (*Mwangi, 2013*). The internationalization strategies for the globalization of commercial banks include social capital as attributes of a global mindset (*Rana & Elo, 2017*) opine that social capital could influence the success of businesses to internationalize. However, it is not evident whether these practices adopted in other industries can be replicated in Kenya's banking industry.

For instance, a few studies on global mindset and internationalization have focused on global mindset and internationalization among small and medium enterprises (SMEs), (*Batas & Liu, 2013; Islam & Van Zijil, 2016; Gota, 2017*), while the few that focused on social capital among commercial banks emphasized the influence of social capital on financial performance and not on internationalization (*Singh et al., 2016*). Most of these studies were also done in other countries with no study conducted in the Kenyan context. It gives evidence of the contextual knowledge gap on the influence of social capital on commercial banks' internationalization in the Kenyan context.

Some studies on social capital and growth of small and medium enterprises done in Kenya (*e.g., Okello, 2017*) did not provide policy implications on matters of social capital and internationalization in commercial banks. It offers a policy gap, which this research sought to address.

Therefore, this study's central question is the essence of the social capital influence on internationalization of commercial banks in Kenya.

3. Empirical background review

A study was undertaken by *Riekmann et al.* (*2018*) on the role of social capital on the internationalization of Small and Medium Enterprises in Germany and China. Specifically, the study undertook an exploration of the related structures dealing with the building of SMEs, maintenance, and usage of the network of resources in Germany and China. The research applied a multi-case study design with a sample of 1,334 SMEs. Online surveys were used in data collection. The findings established that there is a significant role of social capital on the communication and technological context of SMEs in Germany and China.

Lindstrand and Hanell (*2017*) examined the effect of international and market-specific social capital on firms' internationalization in the USA. The study focused on the development of a theory specifying the international and market-specific social capital that has the chance to increase the exploitation of international opportunities. A descriptive research design was employed with the internationalization process theory and social network theory as theoretical foundations. Data was collected from 239 international SMEs operating in the USA. The findings showed that the tentative effect of international social capital on opportunity exploitation has a mediating effect on market-specific social capital. The study also established that the internationalization process affects social capital development in international business opportunity exploitation.

A study by *Masila* (*2018*) investigated the determinants of internationalization strategies employed by elevator industry firms in Kenya to realize competitive advantage. The study adopted a descriptive research design with the study population comprising of twenty firms in the elevator industry in Kenya. Data gathering was through questionnaires that collected both primary and secondary data. Data analysis was conducted through descriptive and inferential statistical methods. The findings established that elevator firms in Kenya used three primary internationalization strategies to achieve competitive advantage; home-based production orientation strategies, contractual-based orientation strategies, and foreign-based orientation strategies. The study further revealed the presence of a positive and significant association between internationalization strategies used and the achievement of competitive advantage by elevator firms in Kenya.

Another study was undertaken by *Cheptarus* (*2017*) assessing the influence of various internationalization models on the performance of airline firms in Kenya. The focus was on discovering the various internationalization methods adopted by Kenyan airlines to establish an association of internationalization and performance. Three theoretical approaches anchored this study; market imperfections theory, eclectic paradigm theory, and transaction cost analysis model. The research design was descriptive design, with a study population of 66 firms in the airline industry and a target population of 66 airlines operating in Kenya. CEOs and senior operation managers of targeted airline firms participated in the study. Data collection was conducted through semi-structured questionnaires. SPSS statistical package was used in data entry and coding with analysis of data employing descriptive and inferential methods. The findings revealed that there is a positive and significant relationship between export strategies of orientation and performance. The findings also established a positive and significant association between investment entry modes and internationalization strategies of airline firms' performance.

Mshighadi (*2017*) examined the association of corporate governance and the internationalization of commercial banks in Kenya. Three theoretical approaches anchored the study: competitive advantage theory, agency theory, and stewardship theory. A descriptive research design formed the basis of the methodology. The research population comprised of 43 licensed commercial banks in Kenya. A census of all the commercial banks was conducted with questionnaires collecting primary data. Secondary data was gathered through publications and journals relating to corporate governance and the internationalization of commercial banks. Descriptive and inferential statistical approaches were used in data analysis, where quantitative data was analyzed using SPSS version 22. The findings established a positive and significant association between corporate governance and the internationalization of commercial banks in Kenya. Additionally, institutional ownership, board composition, and compensation of commercial banks' CEOs had a positive and significant association with commercial banks' internationalization.

Kagucia (*2017*) conducted a study on the internationalization and performance of Kenya Commercial Bank. A case study research design was employed to undertake an in-depth analysis of commercial banks' internationalization and the influence on performance. Primary data was collected through interviews of heads of marketing, operations, and business development at the KCB headquarters. Analysis of the collected data was conducted through content, and textual analysis of the information gathered. The results established that the benefits of the internationalization process to KCB included improved regional integration, expansion of business in new markets, and entry of the bank in fresh markets. The findings revealed that the internationalization process improved KCB's performance through increased market share, profitability, and growth in deposits. The various challenges facing commercial banks' internationalization include the inadequacy of internationalization skills, the limited financial base for internationalization, and weak incentives for investment in foreign markets.

A study was carried out by *Okello* (*2017*) to establish the effect of social capital on the growth of medium enterprises in Kenya. The study employed a descriptive correlation research design on a population consisting of 142 CEOs. It was found that most medium enterprises prefer network diversity for their employees, leading to increased customer network growth over the years. However, engagements in social organizations do not influence the increase as the growing customer network size had positively influenced sales volumes for the firms.

4. Data and methods

4.1. Research procedures

The questionnaires were administered both electronically and print a hard copy for the convenience of the respondents. The use of mail and questionnaires helped to triangulate the results, thereby giving the research results credibility. The process started with a pilot study, which is a pre-study, conducted to test the data collection tools. After the pilot study, the tools were checked for validity and reliability.

4.1.1. Reliability test for social capital

The reliability test indicated that social capital had a Cronbach's Alpha score of 0.925. Further analysis indicated a strong influence on each of the eleven questions; hence the items had minimal variance on Cronbach's Alpha if item deleted; 0.908 to 0.925, which is presented in *Table 1*.

Table 1

Reliability test for social capital*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q10_1	37.2941	48.721	0.709	0.918
Q10_2	38.4118	43.382	0.873	0.908
Q10_3	38.0588	46.809	0.677	0.919
Q10_4	38.0588	44.809	0.736	0.917
Q10_5	38.3529	47.618	0.627	0.921
Q10_6	38.2353	48.941	0.678	0.919
Q10_7	37.8235	47.779	0.776	0.915
Q10_8	37.7059	48.721	0.668	0.919
Q10_9	37.8235	46.779	0.792	0.913
Q10_10	37.4118	49.382	0.545	0.925
Q10_11	37.2941	50.221	0.644	0.921

*Source: compiled by Authors.

4.1.2. Validity Test

Face validity was used to determine the tool's construct, while factor analysis and Average variance extracted (AVE) were performed to evaluate content validity. Face validity was performed to determine the constructs of the questionnaire. It was done in two approaches. On the first approach, the researcher observed the number of questionnaires filled (19 questionnaires), missing data, the sequence of filled questions, type of questions in the questionnaire, language used, among others. In the second approach, the researcher interacted with the respondents and got feedback on the flow of the questions, their understanding, and comprehension. The outcome was as follows:

Key on the identification of the face validity was the absence of the dependent variable. The researcher identified that the dependent variable was missing, and the few questions capturing the dependent variables were weak. Further, the Average Variance Extracted (AVE) was conducted to evaluate convergent validity. *Table 2* indicates that AVE for social capital was above the 0.5 thresholds indicating that the latent constructs account for at least fifty percent of the variance in the items. It indicated that the measurement scales revealed a satisfactory measurement of convergent validity.

Table 2

Convergent validity*

	Composite Reliability (C.R.)	AVE	Verdict
Social capital	0.740	0.636	Acceptable

*Source: compiled by Authors.

4.2. Administration of the instruments

The questionnaires were administered both physically and electronically for the convenience of the respondents. The use of electronic questionnaires helped to triangulate the results, thereby giving the research results credibility. Before this exercise, respondents' consent was established through an introduction letter.

4.3. Data analysis methods

Before data analysis, collected data was cleaned and coded to ease data entry into the SPSS version 22. Analysis of data involved evaluating data using analytical and logical reasoning to examine each component of the data provided. It aimed at discovering useful information, suggesting conclusions, and supporting decision making. Descriptive statistics, through the use of mean, mode, standard deviation, frequencies, and percentages, were used to analyze socio-demographic data. Descriptive statistics involved computing the mean of the statements that reflect on the research questions. A high mean score, higher than the benchmark of 3.5, would imply that there are high levels of agreement among the respondents concerning various research questions. Mean scores between 2.0 and 3.5 would imply that there are average levels of agreement among the respondents. Besides, means score below 2.0 would reveal the existence of below-average levels of consensus among the respondents (*Wultz, 2014*). Structural Equation Modelling was used to establish the influence of social capital on commercial banks' internationalization in Kenya. Analysis of Moment Structures (AMOS) was also undertaken to construct the model linking social capital and internationalization.

5. Results

5.1.Structural Equation Model for social capital and internationalization

The study's null hypothesis was that social capital has no significant influence on the internationalization of commercial banks in Kenya. To reject or fail to reject the hypothesis, the study conducted regression analysis that provided the R-squared value, path coefficients, and model fit results that determine the relationship between the independent variable (social capital) and the dependent variable (internationalization of commercial banks in Kenya). From the results shown in *Fig. 1*, the estimated structural equation model indicates that for every magnitude change in social capital, internationalization increases by 0.57 units.

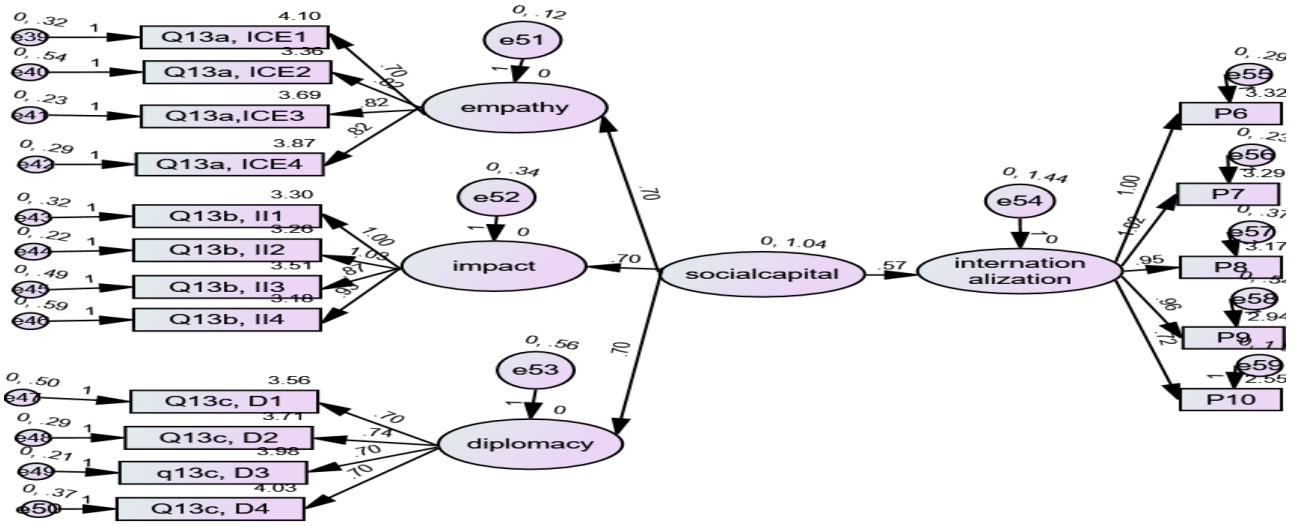

Fig. 1. SEM Model for social capital*

*Source: compiled by Authors.

The model shows that the R-square value was 22 percent, implying that social capital had a significant favorable influence on internationalization and explained 22 percent of the variance in the internationalization (R^2 = 0.22) by commercial banks in Kenya. This R^2 value exceeds 10 percent, which is the recommended threshold by *Falk and Miller* (*1992*) as an indication of substantive explanatory power.

5.2. Path Coefficients for social capital

Table *3* shows the path coefficients for the relationship between social capital and the internationalization of commercial banks. The results show that the relationship between social capital and internationalization was positive and statistically significant (βeta = 0.66, T=5.26, P<0.05). Therefore, the study rejects the null hypothesis that social capital has a significant influence on commercial banks' internationalization.

Table 3

Path Coefficients for social capital*

Path			Unstandardized Estimate	Beta	S.E.	C.R.	P**
Intercultural empathy	<---	Social capital	1.85	0.94	0.57	3.99	0.00
Interpersonal impact	<---	Social capital	2.45	0.69	0.63	4.85	0.00
Diplomacy	<---	Social capital	1.17	0.55			
Internationalization	<---	Social capital	1.46	0.66	0.67	5.26	0.05

*Source: compiled by Authors.
**Note: P < 0.05, P < 0.01, P < 0.00.

6. Discussion

This study found out that the relationship between social capital and commercial banks' internationalization was positive and statistically significant. Studies reviewed have demonstrated the importance of social capital in the implementation of an organization's internationalization strategy. In this study, social capital was considered to include diplomacy, intercultural empathy, and interpersonal impact.

In the Kenyan context, support of the findings comes from a study conducted by *Okello* (*2017*) examining social capital as a factor affecting the growth of organizations, which established that a relationship exists between social capital and expansion, similar to internationalization in the current study. The results of this study strongly suggest relevant practical implications for top managers fostering social capital within the firm and in external relationships. This way, significant benefits are achievable for the bank's knowledge base and international growth. The results support the aspect of the intercultural empathy ability of the manager to possess the connecting ability for local and cross-cultural interests, values, and beliefs that have variations from the national culture with employees or stakeholders in an organization as stipulated by (*Montero, 2016*). The results show that all dimensions of social capital affect the acquisition of foreign market knowledge and financial resources, but the usefulness of individuals' social capital often changes during commercial banks' internationalization.

The findings also correlate with the findings of the study by *Mshighadi* (*2017*) on an examination of the association of corporate governance and internationalization of commercial banks in Kenya. The findings established the presence of a positive and significant association between corporate governance and the internationalization of commercial banks in Kenya. Features of corporate governance highlighted included institutional ownership, board composition, and compensation of CEOs of commercial banks, and they expressed a positive and significant association with the internationalization of commercial banks. To some extent, these corporate strategies can supplement the social capital aspects such as a passion for diversity, the quest for adventure, and self-assurance in the internationalization process of commercial banks in Kenya.

It is notable from the suggestions by *Montero* (*2016*) that the presence of social capital and corporate governance attributes in firms have the potential to simultaneously capturing the unfolding internationalization process and the evolving social relationships between managers and other individuals. Possession of diversity and quest for adventure reflects the focus of interpersonal impact as the capacity of the manager to create active personal and professional networks, for cross-border negotiation skills (*Maike & Franziska, 2017*). Possession of such global-spanning networks reflects the ability of the manager to possess a wide range of cultural experience that creates efficiency in interactions with other employees and organizations. However, as much as this study supports the findings of the current study, there are

conceptual differences in that the focus is on corporate governance and internationalization of commercial banks in Kenya. Similar to the results of the current study, *Kagucia* (*2017*) conducted a study on the internationalization and performance of Kenya Commercial Bank. The findings support the current study to some extent since they established that a significant benefit of the internationalization process to Kenya Commercial Bank (KCB) included improvement in regional integration, expansion of business, and entry of the bank in new markets. As suggested by *Masila* (*2019*), these are attributes of diplomacy that reflected on the ability of the manager to possess inter-cultural empathy and interpersonal impacts for expansion, negotiation, and integration of commercial banks in foreign markets.

The integration and expansion attributes are similar to the internationalization process. The findings of *Kagucia* (*2017*) complement the results by *Lindstrand and Hanell* (*2017*), in their study on the effect of international and market-specific social capital on the internationalization process of firms in the USA that found that internationalization process has an effect on social capital development and expansion in international business opportunity exploitation. However, a conceptual gap is revealed since the focus of the study was a case study of one commercial bank with a current study focusing on forty commercial banks in Kenya. Another study with findings correlating to the current study was by *Masila* (*2018*) that investigated the determinants of internationalization strategies employed by elevator industry firms in Kenya. The findings established that elevator firms in Kenya used three primary internationalization strategies to achieve competitive advantage; home-based production orientation strategies, contractual-based orientation strategies, and foreign-based orientation strategies. The findings on competitive advantage through foreign-based orientation strategies have an internationalization angle. It is due to the basis of focusing on foreign markets, which has an internationalization process. It also integrates the possession of cross-border negotiation skills, global-spanning networks, and cultural experience that creates efficiency in interactions (*Maike & Franziska, 2017*) by managers to enter foreign markets. The findings are comparable to those of a study by *Buckley* (*2016*), which sought to document the contribution of internationalization theory to international business through a descriptive study. The findings suggested that the dimensions of social capital are part of the evolution process of organizations. The contextual gap is that the focus was on the determinants of internationalization strategies employed by elevator industry firms in Kenya.

Finally, another study complementing the current study was by *Cheptarus* (*2017*) assessing the influence of various models of internationalization on the performance of airline firms in Kenya. The findings revealed that there is a positive and significant relationship between export strategies of orientation and performance. By highlighting the importance of export strategies of orientation, the internationalization attempts of airline firms in Kenya are incorporated. The findings also support *Montero's* (*2016*) view on necessity for possession of inter-cultural empathy by the manager for practical local and cross-cultural interests, values, and beliefs in foreign export markets. The basis of this conclusion is summarized by *Anderson et al.* (*2013*) with study findings that indicated that for those organizations without sufficient resources, social capital might provide essential resources for their internationalization strategies like export strategies in the current study.

7. Conclusion

The study concluded that the relationship between social capital and the internationalization of commercial banks in Kenya is positive and statistically significant. Therefore, the social attribute that is possessed by managers, whether it is diplomacy, intercultural empathy, or interpersonal impact, significantly determines the success rate of internationalization strategies by commercial banks.

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9. The competing interests

The authors declare that they have no competing interests.

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Appendices

A – Questionnaire

This questionnaire aims to collect information regarding the influence of the global managerial mindset on commercial banks' internationalization in Kenya. Kindly provide the information required by indicating (√) against each question. The final findings of the study will be availed to interested parties upon request.

THE QUESTIONNAIRE USED THE FOLLOWING TERMS

***Global mindset*:** the mental attitude that determines how individuals will interpret and respond to global situations.

***Intellectual capital*:** The ability to learn, understand information, and gain global knowledge. It includes being global business savvy, cognitive, and being able to analyze information.

Psychological capital: the ability to be open to differences and the ability to change and adapt globally. It includes a passion for diversity, love for adventure, and self-assurance.

Social global capital: the ability to collaborate with other global players. It includes diplomacy, interpersonal impact, and intercultural empathy.

SECTION A: Demographic Information

1. Gender: Male [ ] Female [ ]
2. Age : Below 20 [ ] 21-30 [ ] 31-40 [ ]
   41-50 [ ] Above 50 [ ]
3. Management position:
   CEO/Director [ ] Head of Department [ ]
   Senior Manager [ ] Manager [ ]
4. Does your bank have branches outside Kenya? Yes [ ] No [ ]
5. If yes, in which regions?
   Africa [ ] Europe [ ] America [ ]
   Middle East/Asia [ ] Australia [ ] UK [ ]
6. How big is your branch network in Kenya?
   0-30 branches [ ] 31-60 branches [ ]
   61-90 branches [ ] More than 90 branches [ ]
7. Indicate your bank tier: Tier one [ ] Tier two [ ] Tier three [ ]

SECTION B: Intellectual capital on the internationalization

The *Table A.1* shows the characteristics of intellectual capital. On a scale of 1-5, where: 1- not at all, 2- small extent, 3- moderate extent, 4- large extent, 5- very large extent, choose the alternative that describes you. To what extent do you agree?

Table A.1

The characteristics of intellectual capital

Structural Capital		Level of agreement				
No.	Statement	1	2	3	4	5
SC1	Have knowledge of the global banking industry					
SC2	Have knowledge of globally competitive business					
SC3	Have knowledge of global marketing strategies					
SC4	Have knowledge of how to transact business internationally					
SC5	Have knowledge of how to assess the risk of doing business internationally					
Relational Capital						
RC1	Have knowledge of culture in different parts of the world					
RC2	Have knowledge of geography, history, economic and political issues of different countries					
RC3	Have knowledge of trending topics of different countries					
RC4	Have up-to-date knowledge of significant world events related to banking					
Human Capital						
HC1	Have the ability to grasp new complex concepts with agility					
HC2	Have strong analytical and problem-solving skills					
HC3	Have the ability to understand abstract ideas					
HC4	Have the ability to explain complex issues simply and understandably					

What has been the most efficient way for you to learn about global business trends? (Please select the most applicable answer)
Academic Learning [ ] Newspapers [ ] Internet [ ] Socialism [ ]
Other ……
In your view, how can banks capitalize on intellectual capital on internationalization?

SECTION C: Psychological capital on the internationalization

The *Table A.2* below shows the characteristics of psychological capital. On a scale of 1-5, where: 1- not at all, 2- small extent, 3- moderate extent, 4- large extent, 5- very large extent, choose the alternative that describes you. To what extent do you agree?

Table A.2

The characteristics of psychological capital

Passion for Diversity		Level of agreement				
		1	2	3	4	5
PD1	Enjoy traveling to other parts of the world					
PD2	Enjoy getting to know people from other parts of the world.					
Quest for Adventure						
QA1	Have an interest in dealing with challenging situations					
QA2	Have a willingness to take risks and test one's abilities					
Self-Assurance						
SA1	Feel energetic during working hours					
SA2	Feel self-confident during strategy meetings abroad					
SA3	Feel comfortable in uncomfortable situations					
SA4	Feel comfortable in tough situations					

In your view, how can banks capitalize on psychological capital on internationalization?

SECTION D: Social capital on the internationalization

The *Table A.3* below shows the characteristics of social capital. On a scale of 1-5, where: 1- not at all, 2- small extent, 3- moderate extent, 4- large extent, 5-very large extent, choose the alternative that describes you. To what extent do you agree?

Table A.3

The characteristics of social capital

	Inter-Cultural Empathy	Level of Agreement				
		1	2	3	4	5
ICE1	Have the ability to work well with people from other parts of the world					
ICE2	Have the ability to understand nonverbal expressions of people from other cultures					
ICE3	Have the ability to emotionally connect to people from other cultures					
ICE4	Have the ability to engage people from other parts of the world to work together					
	Interpersonal Impact					
II1	Have experience in negotiating with other cultures					
II2	Have secure networks with people from other cultures					
II3	Have a reputation as a leader					
II4	Have personal contacts that help in scaling up the bank's global business ventures					
	Diplomacy					
D1	Find it easy to start a conversation with a stranger.					
D2	Have the ability to integrate different perspectives					
D3	Have the ability to listen to what others have to say					
D4	Have a willingness to collaborate					

In your view, how can banks capitalize on social capital on internationalization?

SECTION E: Political and legal framework

The table below presents the effects of the political and legal framework on internationalization. On a scale of 1-5, where: 1- not at all, 2- small extent, 3- moderate extent, 4- large extent, 5-very large extent, choose the extent to which you agree with the following statements.

Table A.4

To what extent do you agree?

	Political framework	Level of agreement				
		1	2	3	4	5
PF1	Unstable local legal environment present a risk in the internationalization process					
PF2	An unstable foreign legal environment presents a risk in the internationalization process.					
PF3	The legal environment influence government policies on business going international.					
PF4	The harsh political framework affects the internationalization of business.					
PF5	The political framework of a country influences the extent to which banks go international.					
	Legal framework					
LF1	Tighter restrictions in capital regulations are attributed to a reduction in lending from other countries.					
LF2	The regulatory framework creates high risks for the internationalization of organizations.					
LF3	The legal framework on a country influences the extent to which banks go international.					
LF4	The government subsidies on business affect the internationalization of banks.					
LF5	The currency control by the government affects the internationalization of banks.					
LF6	The framework on the bank tariffs affects the internationalization of banks.					

In your view, how can banks capitalize on the political and legal framework on internationalization?

SECTION F: Joint effect on internationalization

The table below presents the joint effect of social capital, psychological capital, and intellectual capital on internationalization. On a scale of 1-5, where: 1- not at all, 2- small extent, 3- moderate extent, 4- large extent, 5-very large extent, choose the extent to which you agree with the following statements.

Table A.5

The joint effect of social capital, psychological capital, and intellectual capital on internationalization

	Effect on internationalization	Level of agreement				
		1	2	3	4	5
JE1	Through social networking with customers, companies develop intellectual capital					
JE2	The development of social capital has significantly affected factors that shape evolution, intellectual and psychological relationships.					
JE3	Value is created when social capital is aligned with intellectual capital and psychological capital.					
JE4	Social, intellectual and psychological networks are essential for commercial banks seeking to invest abroad					
JE5	Intellectual capital as an asset can be deployed in the creation of social and psychological capital required in internationalization.					
JE6	Building social capital, intellectual capital, and psychological capital in the unknown market may not be natural, even for experienced commercial banks.					
JE7	Intellectual capital has a significant impact on social and psychological capital and has a significant influence on commercial banks' internationalization.					
JE8	Psychological capital is a crucial ingredient of Commercial banks growth for the production of social and intellectual capital					

SECTION G: Performance on internationalization

The *Table A.6* below presents the performance of banks. On a scale of 1-5, where: 1- not at all, 2- small extent, 3- moderate extent, 4- large extent, 5-very large extent, choose the extent to which you agree with the following statements.

Table A.6

The performance of banks

Statements		Level of agreement				
		1	2	3	4	5
P1	We have a correspondence banking relationship with other banks outside Kenya.					
P2	Internationalization has enabled our bank to diversify its risk portfolio.					
P3	We have license agreements with other banks outside Kenya.					
P4	Our bank provides a range of products in other countries.					
P5	Our bank provides a range of services in other countries.					
P6	Our international presence has contributed substantial profits to the group bank.					
P7	Our international presence has improved on our bank asset base.					
P8	In the last three years, our services in international presence have grown					
P9	Our bank has an adequate physical presence in other countries.					
P10	In the last three years, our bank has acquired other banks in the international market.					

Thank you for your responses!

APPENDIX B – Commercial banks in Kenya by tier classification

Table B.1

Classification of commercial banks in Kenya

N	TIER 1: Large banks (Weighted market share index (WMSI) > 5%)	number of banks	N	TIER 2: Medium banks - WMSI between 1% & 5%	number of banks	N	TIER 3 - Small banks WMSI < 1%	number of banks
1	Kenya Commercial Bank		9	I&M Bank				
2	Equity Bank		10	NIC Bank**		20	G.T. Bank	
3	Co-operative Bank of Kenya		11	Citibank		21	Gulf African Bank	
4	Standard Chartered Bank		12	Bank of Baroda		22	Victoria Commercial Bank	
5	Diamond Trust Bank		13	National Bank of Kenya		23	ABC Bank	
6	Barclays Bank of Kenya		14	Prime Bank		24	Sidian Bank	
7	Commercial Bank of Africa *		15	Family Bank Limited		25	Habib A.G.Zurich	
8	Stanbic Bank		16	Housing Finance Company of Kenya		26	Guardian Bank	
	Total - Large Tier banks	8	17	Bank of India		27	First Community Bank	
			18	EcoBank		28	Credit Bank	
			19	Bank Of Africa Kenya Ltd	11	29	Development Bank of Kenya	
				Total - Medium Tier banks		30	Jamii Bora Bank	
						31	M-Oriental Bank Limited	
						32	Trans-National Bank	
						33	Consolidated Bank of Kenya	
						34	Paramount Universal Bank	
						35	SBM Bank	
						36	Spire Bank	
						37	United Bank for Africa	
						38	Middle East Bank	
						39	Mayfair Bank	
						40	Dubai Islamic Bank	
							Total - Small Tier banks	21

*Source: compiled by Authors based on Kenya Bankers Association (http://www.kba.co.ke/overview/kba-members).
**Note: Commercial Bank of Africa & NIC Bank now merged to form NCBA Bank *(Sep, 2019)*.

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Logistics system model optimization of an enterprise producing one type of goods

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Purpose – to develop the logistics system (LS) model of an enterprise that allows performing joint model optimization of production capacity, retail network, and advertising campaign using J. Forrester's approach.

Findings. The paper elaborates on a numerical method for solving the optimization problem based on a system of equations in discrete time form. There we had the time behavior computations of all logistics system rates (production and supply), including the stocks' level in the wholesale and retail sales networks. The optimization problem of determining the maximum economic efficiency is formulated and solved.

Theoretical implications. The paper's research performed in the paper forms a methodological basis for the mathematical model development of various logistics systems.

Practical implications. The created model is applicable for optimizing or determining the logistics systems' optimal parameters.

Originality/Value. The authors' logistics system model is original. The model has no analogs in the scientific literature.

Research limitations/Future research. The main limitation is producing one type of product by an enterprise. Further research should reflect the product diversification possibility.

Paper type – theoretical.

Keywords: Logistics System, Production Capacity, Economic, and Mathematical Model.

Paper type – theoretical.

Keywords: logistics system, production capacity, economic, and mathematical model.

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Модельна оптимізація логістичної системи підприємства, що випускає один вид продукції

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Мета роботи –розробити модель логістичної системи (ЛС) підприємства, на підставі якої можна виконувати спільну модельну оптимізацію виробничої потужності, мережі роздрібної торгівлі й рекламної кампанії, застосовуючи підхід Дж. Форрестера

Результати дослідження. Розбудовано чисельний метод розв'язку проблеми оптимізації, заснований на системі рівнянь, записаних у формі з дискретним часом. Виконані обчислення часової поведінки всіх темпів логістичної системи (темпу виробництва, темпу поставки), так само як поведінки рівня запасів в оптовому складі й у роздрібному продажу. Оптимізаційна проблема визначення максимальної економічної ефективності сформульована й вирішена.

Теоретичне значення дослідження. Цим дослідженням створено методологічну базу для розробки математичних моделей різноманітних логістичних систем.

Практичне значення дослідження. Створена модель може бути застосована для оптимізації або визначення оптимальних параметрів логістичних систем.

Оригінальність/Цінність/Наукова новизна дослідження. Модель логістичної системи, яка запропонована авторами, є оригінальною. У цієї моделі немає аналогів у науковій літературі.

Обмеження дослідження/Перспективи подальших досліджень. Основне обмеження – це випуск підприємством одного виду продукції. В подальших дослідженнях має бути відображена можливість диверсифікації видів продукції.

Тип статті – теоретичний.

Ключові слова: логістична система; продуктивність; економіко-математична модель.

Модельная оптимизация логистической системы предприятия, выпускающего один вид продукции

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Цель работы – разработать модель логистической системы (ЛС) предприятия, позволяющей проводить совместную оптимизацию модели производственных мощностей, розничной сети и рекламной кампании, используя подход Дж. Форрестера.

Результаты исследования. Разработан численный метод решения задачи оптимизации, основанный на системе уравнений в дискретной временной форме. Там у нас были расчеты динамики всех показателей логистической системы (производства и поставок), включая уровень запасов в оптовых и розничных торговых сетях. Сформулирована и решена оптимизационная задача определения максимальной экономической эффективности.

Теоретическое значение исследования. Этим исследованием создана методологическая основа для разработки математических моделей различных логистических систем.

Практическое значение исследования. Созданная модель применима для оптимизации или определения оптимальных параметров логистических систем.

Оригинальность/Ценность/Научная новизна исследования. Авторская модель логистической системы оригинальна. Модель не имеет аналогов в научной литературе.

Ограничения исследований/Перспективы дальнейших исследований. Основное ограничение - производство одного типа продукции на предприятии. Дальнейшие исследования должны отражать возможность диверсификации продукции.

Тип статьи – теоретический.

Ключевые слова: логистическая система; производственные мощности; экономико-математическая модель.

1. Introduction

This paper developed the interdependent model optimization system of production capacity, retail sales network, and product advertising. The presented algorithm of model computations allows performing coordinated production capacity optimization, retail sales network, and the enterprise advertising depending on the logistics system's main parameters. The main focus is on the retail sales network as an essential link that largely determines goods sales.

The papers (*Wang, Chen, Chen, 2008; Kelly, Kerr, Drennan, 2010*) presented "the fuzzy structure ranking method of preferences to evaluate enrichment" (PROMETHEE fuzzy method) that allowed potential suppliers evaluation by several criteria.

Several papers offer some models of advertising campaigns. The paper (*Xiuli, Ashutosh, Suresh, 2009*) deals with joint advertising for the manufacturer and retail sales and prices in a dynamic stochastic supply chain. The authors developed the supply chain problem model as a stochastic differential Steckelberg game.

The paper (*Du, Xu, 2012*) builds a hybrid pricing strategy based on CPM and CPC variables. Subsequently, a new multi-purpose model for solving web advertising resources based on a hybrid pricing strategy is put forward.

Recently, the model approach has actively been applied in the economics of sociology. Notably, there is an influence modeling of some behavioral factors on the frequency of consumer purchases of green goods (*Marques, Almeida, 2013*). The next direction of optimization modeling refers to the problem solution of joint (cooperative) advertising at the manufacturer of a supply chain - retail sales. The papers (*Xie, Neyret, 2009; Ching-Shih, Hsiao-Hua, Hui-Chiung, Chih-Ho, 2009*) devoted to the joint strategy of the advertising campaign and the pricing; as the authors chose such areas as production and retail sales for the research.

The papers (*Wei, & Choi, 2010; Kogler, Rauch, 2018*) consider the mean-variance analysis. The average variance method allows the authors to solve the supply chains' coordination problem according to the wholesale pricing and profit distribution.

The paper aims to create a reference model of business processes for the supply chain, which would include the special conditions when moving perishable goods.

2. Objectives

The study aims to develop an economic and mathematical model of an enterprise's production activities, including the retail sales network, developed model application for joint production capacity optimization, retail sales network, and the enterprise advertising on the daily demanded goods.

3. The research methods and information sources

Many aspects of planning the current activities of enterprises are studied. For instance, *Pedchenko* (*2011*) proposed a dynamic model of market pricing and production, which allows determining the general patterns of production and technological specifics for the economic system evolution. The theoretical basis for creating a model is the balance relations that combine the approaches of L. Walras and A. Marshall to describe the dynamics of prices and volumes of industrial goods in the one product market. The synthesized mathematical model is a system of two linear differential equations for determining the price and volume of goods in discrete time. For this dynamic system, the equilibrium position stability conditions we obtained with the corresponding parametric analysis.

In his paper, *Voronov* (*1997*) built and analyzed models of consumers' behavior of the one type of goods by simulation modeling methods, namely, agent modeling methods. Ferber's reactive agent model is used to determine the agents' behavior within the simulation model. In the reactive agents' models, a specific feature is the states and transitions' concept and behavior tools such as "stimulus-response."

Gvozdetska (*2011*): applies the system of quantitative and qualitative research methods in the management process (adaptive approach). The modeling of a real economic enterprise, including the outside environment, is performed. Probabilistic decision-making methods in an unstable market environment are widely used, as well as information systems, models, and methods with a single information base and capacity to adapt to changing conditions.

Meanwhile, the logistics systems models are actively developed and discussed (*Mushunje, 2019*). Many papers (*Du et al., 2012; Guha et al., 2010; Marques et al., 2013*;) offer different models of advertising campaigns.

Various aspects of logistics systems are actively studied in the modern scientific literature (*Bortolinietal., 2015; Mihalovič, 2016; Morozova et al., 2013*). The authors (*Velychko & Velychko, 2017*) presented a methodology for building logistics models in the individual market systems' management of enterprises according to the minimization and maximization criteria.

Those papers do not sufficiently disclose the quantitative relationship between the logistics system parameters of an enterprise and the consumer market's current features: the potential demand for goods and the goods consumption rate. This modern theory deficiency complicates the study of the advertising campaigns' impact on the enterprise's economic efficiency. *Gorsky* (*1998*) proposes the model that meets the formulated requirements from a fundamental perspective. This model allows considering the detailed features of the market. Nevertheless, the model has a significant deficiency, leading to unstable solutions in a wide range of parameters. *Sherstennikov* (*2013*) proposed the method to eliminate that deficiency. The method is based on averaging the sales rate and goods delivery over a while. Today, there are no effective methods to plan a real-time advertising campaign for an enterprise covering the enterprise logistics and market demand for goods. Some approach principles were introduced by *Sherstennikov and Yakovenko* (*2019*).

4. Results

Fig. 1 reflects the enterprise logistics system. Working in a competitive market requires the enterprise manager to expand the enterprise's market niche or maintain it at some acceptable level. One of the effective means is to conduct a periodic or permanent advertising campaign. Therefore, the model creation begins with a model description of the potential demand Q's advertising campaign's impact.

Fig. 1. The enterprise logistics system*

*Source: developed by the authors.

We assume that in each period t the costs of the for enterprise advertising are constant and equal to Zr. With such costs, some value of potential demand Qpr is achieved. We assume that the model of the first-order delay (*Sherstennikov, 2013*) describes the advertising campaign impact on the current potential demand Qt:

$$dQ\,\frac{Qp(Zr)-Q(t)}{tr}. \quad (1)$$

The potential demand maximum value Qpr depends on the advertising campaign cost. The potential demand maximum value Qp as the costs' function Zr reaches enrichment - this value at any cost can not exceed some maximum value

$$Qmax(Zr) = Qmax * (1 - \exp\{-\alpha * Zr\}), \quad (2)$$

wherein α is a constant that depends on the market and the product in question.

The paper summarizes the approach of J. Forrester (*Forrester, 1958; Forrester, 1971*) that allows evaluating the market demand for goods.

The equation (1) means that the contribution to potential demand caused by the advertising campaign Q_i is described by the first-order delay model (*Sherstennikov, 2013*).

Let us formulate a system of equations that describe the enterprise's logistics system shown in *Fig. 1.* We believe that the enterprise is wholly provided with running costs. The system of equations determines the defining performance of the logistics system in the finite-difference form. That means that we consider the time to be discrete. *Yakovenko* (*2017*) considers general principles of economic dynamics applied below to a separate enterprise.

1. Demand change Q_i on the goods at the market is the enterprise's input impact, which aims to align its output with demand. Sales rate

$$r_{i+1} = rR_i \cdot (Q_i - V_i) \quad (3)$$

wherein r_i is the goods sales rate (units/period) in the i-th period; n is the parameter, which is determined by the average number of sales for the previous quarter (or year); R_i is goods level in the retail sales network (RS N) in the i-th period; $V_i$is quantity of goods in consumers' hands (not yet consumed).

2. The level of the goods (goods quantity) in the retail sales network R_i determined by a recurrent equation:

$$R_{i+1} = R_i + R \cdot (so_i - r_i)\,, \quad (4)$$

wherein so_i is the supply rate (units/period) from the wholesale warehouse to RS N; Td is the model sampling period, the time interval between the adoption of solutions (choose Td(day)).

3. Level R_i must be within $0 \le R_i \le R_m$, wherein R_m is the goods' maximum possible level to RSN. This requirement is met by the following equation for the supply rate from the wholesale warehouse to RSN:

$$so_{i+1} = so, \quad (5)$$

wherein S_i is the goods stock level in the wholesale warehouse.

The paper substantiates the need to perform averaging when computing the proposed model:

$$\overline{so}_i = \langle so \rangle_{i-ps}^{i}, \quad (6)$$

wherein ps is averaging time interval.

4. The production pace y_i is determined by the following equations:

$$y_{i+1} = \left(y_i + \frac{ym - y_i}{ty}\right) \cdot S_i, \quad (7)$$

$$S = \begin{cases} 1, if\ S_i < qS * S_m, \\ \frac{qS * S_m}{S_i}\ \ otherwise, \end{cases} \quad (8)$$

wherein y_i is production capacity in i -the period; ym is the of production capacity planned value; Sm is the maximum level of goods in the wholesale warehouse. The equation avoids the overflow of the wholesale warehouse.

5. The goods stock level in the wholesale warehouse S_i computed as:

$$S_{i+1} = S_i + S * (y_i - so_i), \quad (9)$$

wherein y_i is the flow rate, which is part of the wholesale production.

6. Adopted the following equation to determine the net profit:

$$M_i = (1 - kp) * [(1 - kad) * Mr_i - rc * -k * S_i - z * Rm - z1 * (Rm)^2 - qz \cdot Z], \quad (10)$$

wherein c is the cost-share in the production cost; p is the unit price; k is payment for storage of the good unit for one period in a wholesale warehouse; kp is the income tax rate; kad is the value-added tax rate.

The equation for net income includes a quadratic dependence on the RSN maximum capacity, which under the contract is assigned to the manufacturer's goods. This dependence can occur for several reasons. For example, as the RSN outlets increase, the delivery distance increases, etc.

5. Discussion

Computed by model (1) – (10) we will perform at such values of parameters:

$Rm0, qy = 100, \mathrm{Q} = 1200, \mathrm{n} = 0.0001, \mathrm{k1} = 0.33,$

$k = 0{,}01, So = 100, Sm = 200, Ro = 50, n1 = 011, So, 80$ (11)

$\mathrm{kp} = 0{,}25, \mathrm{kad} = 0{,}06, \mathrm{c} = 0{,}6, \mathrm{p} = 100\mathrm{z} = 0{,}01, Sm.$

The enterprise's management needs to solve the following two tasks. First (I) is to determine the optimal parameters of the logistics system. The second (II) is to bring the enterprise production capacity in line with current market demand.

Before proceeding to the formal solution of problems (I) and (II), make sure that the model (1) – (10) leads to meaningful results. At the transition from continuous time to discrete, we perform designations replacement $Mt \to M_i$ (and for other quantities). Equation (2) at $Qmax$i $\alpha 2$ leads to the maximum value dependence of potential demand Qpт from costs Zra of advertising campaign depicted in *Fig. 2*.

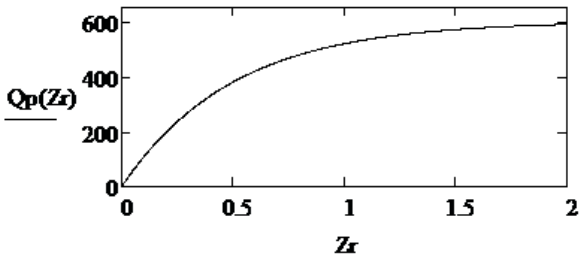

Fig. 2. The maximum value dependence of potential demand Qp from costs Zr(hrn/period) for an advertising campaign*

*Source: developed by the authors.

Let the maximum enterprise productivity (see equation (7)) $ym = 4{,}6$. Let us ask for some values of advertising costs - $Zr = 0{,}9$. Then $Q(0{,}9) = 500{,}8$, according to equation (1), we obtain the dependence shown in *Fig. 3*.

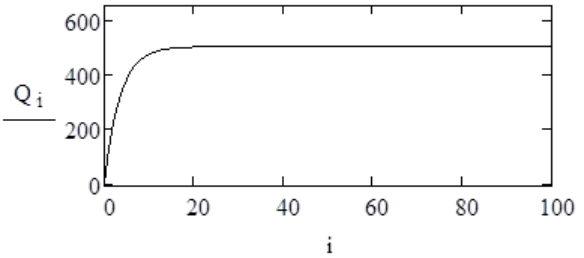

Fig.3. The current value of potential demand*

*Source: developed by the authors.

Next, for the planning horizon, $T \equiv im = 365$ using other model equations for the values of parameters (11), we obtain the results shown in *Fig. 4* and *Fig. 5*.

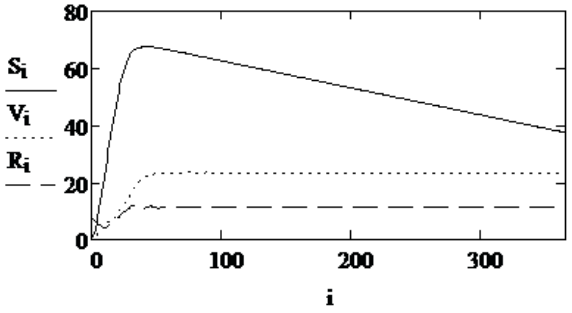

Fig. 4. Current quantities of goods in the wholesale warehouse S_i, in the retail network R_i and goods in the consumer's hands V_i*

*Source: developed by the authors.

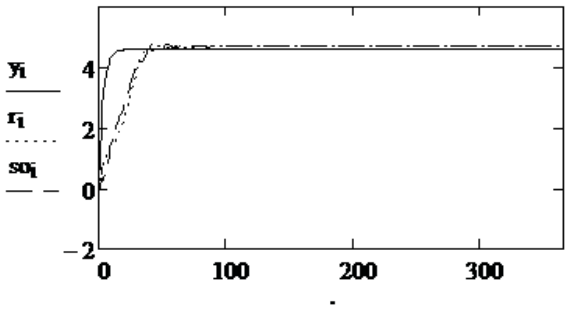

Fig. 5. Current values of the production rate y_i, sales r_i, and the delivery rate from the wholesale warehouse to retail sales so_i*

*Source: developed by the authors.

Відставання темпу продажу й темпу перевезень від темпу виробництва в плині перших 20 періодів (днів) пов'язане з тим, що як видне з рис. 4 у ці періоди товар в основному надходить на оптовий склад а не в роздрібний продаж. Хоча в наступні періоди, як видне з рис. 5 темпи продажу й перевезень трохи перевершують темпи виробництва. З рис. 4 видне, що ця перевага досягається за рахунок зменшення запасів на оптовому складі. При цьому дотримується баланс товару: зроблений товар – реалізований товар = зміна кількості товару на всіх рівнях. Для нашого випадку розрахунки дають:

The sales lag rate and the delivery rate from the production rate during the first 20 periods (days) is due to the fact that, (see *Fig. 4*), during these periods the goods are mainly delivered to the wholesale warehouse and not to retail sales. Although in subsequent periods, (see *Fig. 5*), rates of sale and delivery slightly exceed the production rates. Fig. 4 demonstrates that reducing stocks in the wholesale warehouse leads to this advantage. At the same time the goods balance is observed: the produced goods - the realized goods = change of goods quantity at all levels. For our case, computations are as following

$\sum_{i=0}^{im-1}(y_i - r_i) = 36{,}463, \;\; (iR)_{im} - (S - R)_0 = 36{,}463,$

i.e., the goods balance is performed.

Thus, we made sure of the model adequacy and can proceed to solve the set problems.

The optimal parameters determination of the logistics system. As the optimality criterion, we chose the total profit that the enterprise receives for the year:

$$F(Rm, ym, Z) = \sum_{i=1}^{365} M_i \to max. \quad (12)$$

The optimization problem is as follows. Find the objective function (12) maximum for the following variation parameters: ym is the planned value of production capacity; Rm is the RSN, Z advertising costs in one period (each period has the same costs).

The constraints for the optimization problem (12) are the system of equations (1) - (9).

Previous experience shows that the financial result (F) significantly depends on the RSN's initial filling, i.e., the R_0 value. For technical reasons, R_0 can have the following three values $R_0 = 10, 40, 60$.

Therefore, the optimization problem (12) must be solved separately for three values R_0.

The optimization problem solution at $R_0 = 10$ is as follows.

$$\begin{pmatrix} Rm_{opt} \\ y_{opt} \\ Z_{opt} \end{pmatrix} = \begin{pmatrix} 84{,}3 \\ 6{,}46 \\ 56 \end{pmatrix}. \quad (13)$$

The total profit is as follows

$$F(Rm_{opt}, y_{opt}, Z_{opt}) = 10311{,}7. \quad (14)$$

Fig. 6 illustrates the found optimal solution.

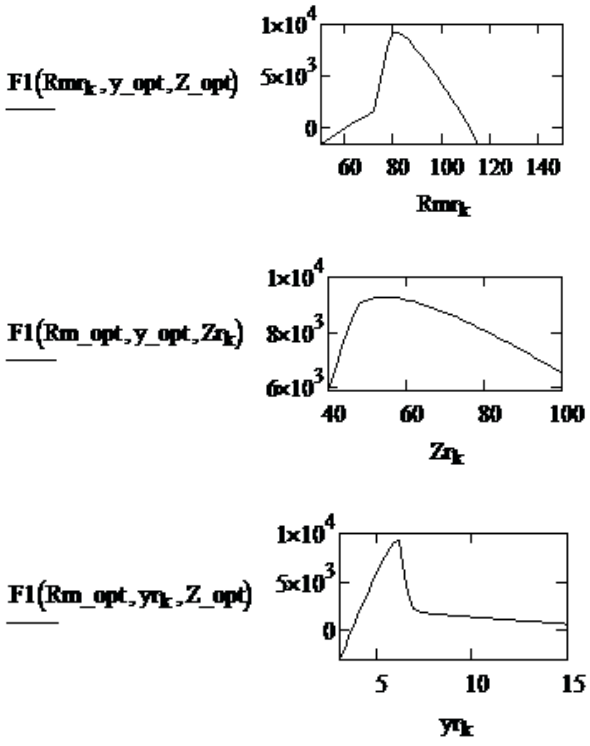

Fig. 6. Graphical demonstration of the optimal solution (12), (13) for $R_0 = 10$*

*Source: developed by the authors.

Fig. 6 shows the changes in total profit on one of the parameters at fixed values of the other two in the case when the RSN initial filling is 10 (units of goods).

The solution to the optimization problem at $R_0 = 40$ is as follows.

$$\begin{pmatrix} Rm_{opt} \\ y_{opt} \\ Z_{opt} \end{pmatrix} = \begin{pmatrix} 90 \\ 7{,}1 \\ 49 \end{pmatrix}.$$

with

$$F(Rm_{opt}, y_{opt}, Z_{opt}) = 14258{,}3. \quad (15)$$

Similarly, the optimization problem solution at $R_0 = 60$ is as follows.

$$\begin{pmatrix} Rm_{opt} \\ y_{opt} \\ Z_{opt} \end{pmatrix} = \begin{pmatrix} 105 \\ 8{,}7 \\ 64 \end{pmatrix}. \quad (16)$$

with

$$F(Rm_{opt}, y_{opt}, Z_{opt}) = 16419{,}4. \quad (17)$$

For clarity, we present the results in tabular form:

Table 1

Dependence of the enterprise's total profit for the year (F1) on the RSN initial completion (R_0)*

R	$F(Rm_{opt}, y_{opt}, Z_{opt})$
10	10311,7
40	14258,3
60	16419,4

*Source: developed by the authors.

The results comparison from *Table 1* illustrates a significant dependence of the financial result on the RSN initial filling. To understand this, we perform detailed dynamics computations of the leading indicators in the LS. *Fig. 7* depicts the dynamics of the LS's main flows.

Fig. 7 shows that when $R_0 = 60$ are the absolute values of all flows are far larger. So the total number of goods sold per year is: $\sum r = 2286{,}3$ (for $R_0 = 10$) and $\sum r = 3119{,}9$ (for $R_0 = 60$). This difference in the number of goods sold per year (see *Fig. 8*). We can observe the comparison of optimal solutions (13) and (17) $R = 84{,}3$, for $R_0 = 10$, $R = 105$ for $R_0 = 60$.

Moreover, *Fig. 8* illustrates that RSN Ri's current product values R_i are near the R's corresponding maximum values.

However, as follows from equation (3), the current values of the sales rate r_i are determined by the R_i value (as one of the factors).

Another contribution to the total profit is due to the quantity of the goods in the wholesale warehouse S_i (*Fig. 9*).

Equation (10) demonstrates that the model adopted the following contractual payment form with the wholesale warehouse: the enterprise pays only for the quantity of the wholesale warehouse's actual goods. Therefore, a larger number of goods in the wholesale warehouse (for $R_0 = 10$) requires higher storage costs. Let us compare the current profit of the enterprise at different values R_0 (*Fig. 10*). The initial work period attracts our attention. At $R_0 = 10$ at the beginning of work, there is a considerable period ($of\ 0 \le i \le 60$), where the current profit value takes significant negative values (up to -100). Formula (10) shows that the enterprise's current profit value is mainly determined by the sales ratio r_i and the production pace y_i. The initial rate comparison for the specified period is shown in *Fig. 11*. *Fig. 11*, including equation (10), explains the current enterprise profit behavior, demonstrated in *Fig. 10*.

It is bringing the enterprise production capacity under current market demand. We consider the problem of bringing the enterprise production capacity, which operates according to the

model (1) - (10) with the current market demand in the following two formulations:

A) the production rate exceeds the sales rate, but due to the advertising campaign, the demand for goods may be increased, and the sales pace becomes equal to the production pace;

B) in any (even the most intensive) advertising campaign, the sales rate cannot be increased so that it equals the production rate. In this case, one has to perform the optimal limitation of the production pace.

Fig. 7. Dynamics of main flows: left for $R_0 = 10$, right for $R_0 = 60$*

*Source: developed by the authors.

Fig. 8. Dynamics of available stocks of goods in RSN: left for $R_0 = 10$, right for $R_0 = 60$*

*Source: developed by the authors.

Fig. 9. Dynamics of available goods stocks in the wholesale warehouse S_i: left for $R_0 = 10$, right for $R_0 = 60$*

*Source: developed by the authors.

Fig. 10. Dynamics of current enterprise profit: left for $R_0 = 10$, right for $R_0 = 60$*

*Source: developed by the authors.

Fig. 11. Dynamics of sales r_i and the production pace y_i: left for $R_0 = 10$, right for $R_0 = 60$*

*Source: developed by the authors..

If the advertising campaign lasts less than the duration of the project, the equation is as follows:

$$Q_i = ZR\left(QS_i - \frac{QS_i}{tr}\right),$$

wherein $ZR = \begin{cases} ZR & i < Tost \\ 0 & otherwise \end{cases}$, $Tost$ is the stopping moment of the advertising campaign. The equation computations led to the result shown in *Fig. 12*.

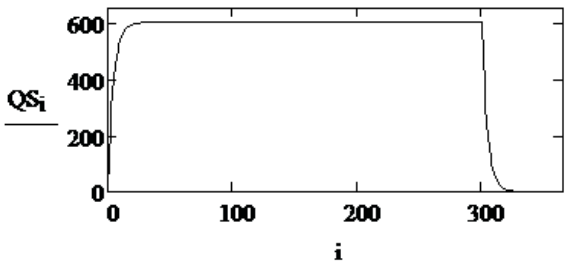

Fig. 12. Current demand dynamics, if the advertising campaign ends at $Tost$*

*Source: developed by the authors.

In this case, the results are shown in *Fig. 13* and *Fig. 14* replace the results shown in *Fig. 8* and *Fig. 9*.

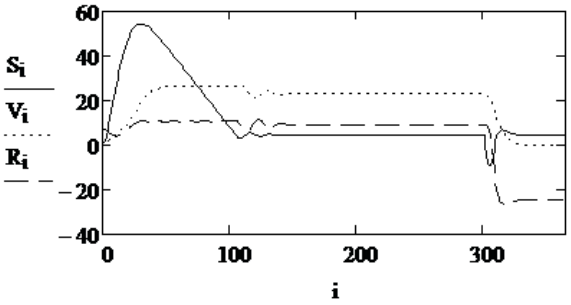

Fig. 13. Current quantities of goods in the wholesale warehouse S_i, in the retail sales network R_i and goods in the consumer's hands V_i at $Tost$*

*Source: developed by the authors..

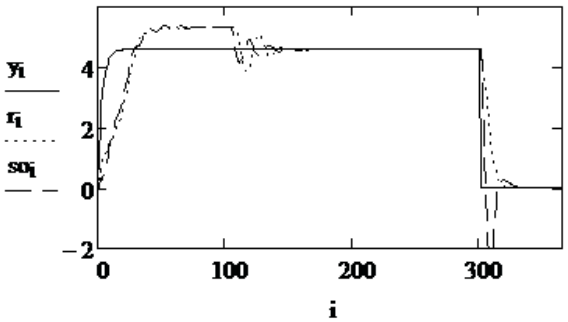

Fig. 14. Current values of production rate sy_i, sales r_i, and the delivery pace from wholesale to retail so_i*

*Source: developed by the authors.

Task A) is reduced to the advertising campaign optimization at a given production pace. As a target function of the optimization problem, we take the profit received for the selected period T (horizon planning):

$$F_T(Zr) = \sum_{i=1}^{T} M_i \to ix. \quad (18)$$

The system of constraints for the optimization problem (18) is a system of model equations (1) - (10). Numerical methods must solve the optimization problem (18) under constraints (1) - (10). Given (10), we see that expression (18) for the objective function can be divided into two parts:

$$F_T(Zr) = F - (1 - kp)TZr, \quad (19)$$

wherein G in relation (2) has a similar (2) dependence on Zr, i.e., G is the convex upwards function. We conclude that in order for the function, $F_T(Zr)$ has a maximum at Zr; the condition $\left(\frac{dG(Zr)}{dZr}\right)_{Zr=0} > (1 - kp)dG$ must be met. If the condition $\left(\frac{dG(Zr)}{dZr}\right)_{Zr=0} \le (1 - kp)dG$ is met, then function $F_T(Zr)$ has maximum at Zr. For $T = 365$ the values of the parameters specified in (11) allow checking by numerical computations that the inequality is performed $\left(\frac{dG(Zr)}{dZr}\right)_{Zr=0} > (1 - kp)dG$, 5*10⁴>343,1). Thus, the function $F_T(Zr)$ has a maximum of non-zero value Zr.

Numerical computations show that the function $F_T(Zr)$ has a single maximum at $(Zr)max = 1{,}245$, while the objective function reaches its maximum value $[F_T(Zr)]_{max} = 1105$.

Fig. 15 and *Fig. 16* demonstrates the dynamics of economic features for an optimal solution.

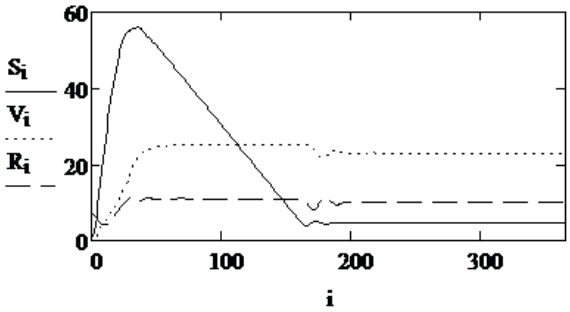

Fig. 15. The same as Fig. 13, but for an optimal solution*

*Source: developed by the authors.

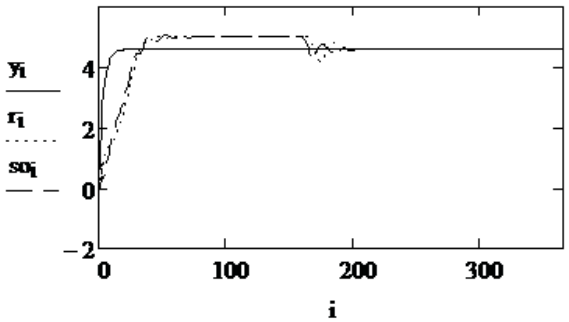

Fig. 16. The same as Fig. 14, but for an optimal solution*

*Source: developed by the authors.

Let us move on to task B). Let now the enterprise maximum productivity $ym = 5{,}0$ (at constant other parameters). If all opportunities to increase demand are exhausted, then there is only a decrease in production. To do this, we apply the non-overcrowding criterion of available wholesale warehouses. In this case, it is necessary to adjust production capacity to market demand for goods. Then instead of equation (7), one needs the following equation, which has the finite-difference form:

$$y_{i+1} = \left(y_i + \frac{ym - y_i}{ty}\right) \cdot \begin{cases} 1, \ if \ S_i < Se \\ \frac{Se}{S_i}, \ otherwise \end{cases}, \qquad (20)$$

wherein *Se* permissible (close to the maximum) production level in the wholesale warehouse.

Now the model computations (1) - (10) (including the equation replacement (7) by (20)) leads to the results shown in *Fig. 17* and *Fig. 18*.

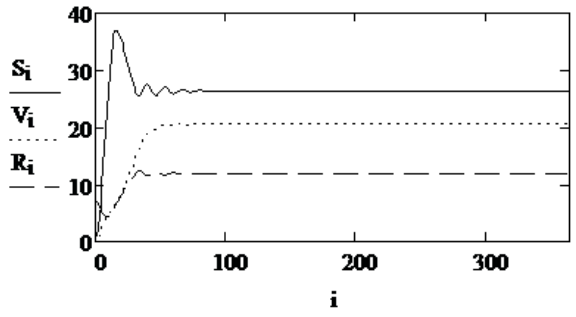

Fig. 17. The same as Fig. 13, but for enterprise maximum productivity $ym = 5,0$*

*Source: developed by the authors.

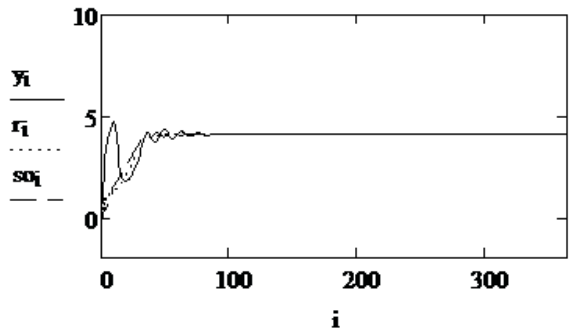

Fig. 18. The same as Fig. 14, but for enterprise maximum productivity $ym = 5,0$*

*Source: developed by the authors.

Computations show that starting from the 80th period; the production rate fluctuates slightly in value $y = 4{,}1$ $(4{,}07 < y < 4{,}13)$. In this case, the profit is 278,5 (see *Table 2*).

Table 2

The profit value depending on the maximum enterprise productivity*

ym	$\sum M$	$y_{ср}$ starting from the 80th period
5,0	278,482	4,08
4,0	655,9	3,892
3,95	665,989	3,846
3,93	665,105	3,93
3,9	661,059	3,9
3,85	649,892	3,754
3,8	635,532	3,708

*Source: developed by the authors.

The average production rate is set at 4,08 (starting from the 80th period). That means that 0,92 $(5 - 4{,}08 = 0{,}92)$ of enterprise capacity units are superfluous and can be involved in producing other production types. Table 2 reflects the optimal production capacity within $3{,}93 < y_{опт} < 3{,}95$. When choosing the production capacity within those limits, the total profit for the period $(T = 365)$ will be around 666 (hrn per unit).

6. Conclusions

The developed enterprise logistics system model allows performing mutually agreed production capacity optimization, retail sales network, and advertising campaign of an enterprise, i.e., those links that directly determine the production and sale of goods, and by a closed system of equations determine the performance of all other parts of the logistics system. The proposed model allows an enterprise to plan its optimal advertising campaign. The model also allows computing the enterprise optimal production capacity when the market for this product is close to saturation, and the advertising campaign no longer completely solves the implementation problem.

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8. The competing interests

The authors declare that they have no competing interests.

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