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ON VIRUSES AND HUMANS: PSYCHOLOGICAL AND CULTURAL CHALLENGES TO HUMAN RESOURCES MANAGEMENT IN REMOTE WORKING CONDITIONS²

The current Covid-19 pandemic provoked alternative work arrangements and a large proportion of employees started to work from home. Despite the initial technological euphoria, this change started showing not only positive, but serious negative phenomena in terms not only of organization and daily practices, but also of psychological and managerial nature. It brought a lot of new questions and problems concerning all soft management elements, especially in the domains of corporate cultures, work motivation and individual psychological responses. This article provides an overview of some major issues of this type and offers ways of tackling them. The new normal is not exactly normal and the old one already seems irrevocably lived-through. While there is no doubt that the future will offer a lot more flexibility and various options for combined distant and office work arrangements, this article explains why the current extent of working from home should rather remain as a transitory element responding to the exceptional circumstances.

Keywords: Organizational culture; distance working; working from home; human resources management; Covid-19

JEL: M12; M14; Z13

The unforeseen and sudden onset of the pandemic has changed a lot in the way we live, communicate and work. The processes of change continue dynamically – with the change of some elements, the consolidation of others, the deepening of the third, and the attenuation of the fourth. We are generally on the way to the so-called “new normality”, which will inevitably involve a return to certain aspects of the old but will also bring something new, different, unmanifested before the onset of pandemic times. One of the most significant phenomena accompanying the development of the pandemic situation is working from home (WFH, work online, home office, telecommuting, etc.)

The trend towards greater flexibility in working schedules is not new, but it has developed along an exponential curve and has been enriched with flexibility in terms of workplace location. The outbreak of the global health crisis has forced the slow and hesitant introduction

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of new computer technologies into the work and communication of large groups of people. Platforms like Teams and Zoom are not new, but their use had not become a priority before the imperative change of scenery took place.

Perhaps understandably, the main focus, in the beginning, was on the technological and logistical aspects of the new type of work in an electronic environment: work organization, hardware, software platforms, legal dimensions of the new type of jobs. The first euphoric reactions appeared, the result of the relatively fast and successful dealing with the technological solutions in question. The technocrats put on their pink glasses and talked about the end of the offices. Employers quickly saw a chance to cut office costs. There was also a wave of elation among employees who did not have to travel in the morning and evening and who could work without going to work at the same time. When the cloud of chaos and ambiguity began to dissipate, however, it turned out that the picture was not so simple and contained many questionable and unavoidable problems.

Quite naturally, many psychological, cultural, and practically all soft factors of management (as well as some harder ones) which had been left somewhere beyond the focus of attention, began to remind for themselves. The key and seemingly already recognized the importance of organizational cultures, time-tested motivational practices, and leadership, which seemed to have been forgotten and underestimated, again became clearly relevant in the context of the new pandemic conditions and remote work models.

In fact, the issue is multifaceted, because there is a difference between having operational teams moving from office to WFH and communicating via any of the electronic platforms, and having teams created for work in such conditions. The problem can be expected to be different if the culture found before the pandemic was good and if it was not. There are obvious differences too in the perspective of the different businesses, industries, spheres of activity, and professions, where due to the nature of the work itself, the new conditions are differently new and the effect of them can be very different. Of course, individual personal characteristics and the cognitive and behavioural tendencies they carry, as well as age and status differences, continue to be important. But there is already data and a basis for identifying and understanding some common phenomena and trends related to work from home.

A recent survey (Qualtrix-Quartz, 2021), covering 2100 respondents from Europe, Asia, North America, and Australia, shows some results in the field of interest. In June 2020, 19% of the respondents disliked working from home, compared to 54% who approved with significant differences between large ethnocultural groups: only 39% of Europeans welcomed home office, compared with 67% in Africa and 66% in Asia, 55% in Australia and 60% in North America. There is also a significant difference between the opinions of the respondents according to the size of the organization: 62% approval among employees for large corporations and 46% among representatives of small and medium-sized organizations. Despite these estimates, no less than 60% of the respondents said they would be happy to return to office work, at least to some extent, and only 18% did not like the idea at all. If it is not a question of a complete resumption of the office presence, but of finding a combination of work from home and office, almost 70% answer with a positive attitude, while at the same time, only about 1/3 of the respondents think that their employers will be prone to flexibility

in this regard. In this regard, there is a significant cultural difference again – US companies are twice as flexible as European ones in terms of when and how to return – at least in part – to traditional ways of working.

The survey shows that 70% of respondents define the pre-Covid culture of their organizations as good and they are the ones who (2 times more often than the others) believe that the new conditions have catalyzed positive cultural changes. Those with a clear negative attitude towards their organizational culture before the pandemic are almost 4 times more likely to describe the development of the culture in their organizations after the onset of the pandemic as deterioration. Overall, 37% of the respondents find that there is a positive development of culture due to the new conditions, and 15% do not hesitate to give unequivocal feedback, with men being almost 50% more likely than women, to approve of the new status quo. Here, too, there is a geographical (ethnocultural) difference, with 45% of North Americans more likely to describe the changes as positive, compared to 34% of European respondents.

48% of people find that they feel more connected to their colleagues, and 18% are of the opposite opinion. Among the former, those who have defined the post-Covid development of their previous organizational culture as positive, predominate, and among them, men are twice as many as women. About half of the respondents believe that the new conditions have strengthened their sense of loyalty to the organization, but for the most part, they are the same ones who liked the pre-pandemic culture in the workplace. Again, slightly more than half of the respondents self-identify as more focused in the new conditions, and again these are predominantly the same who approved of the previous culture in their organization and those who generally see the changes in an optimistic light.

Table 1 shows the answers to the question, which are the characteristics of the organizational climate which are decreasing, which stay more or less the same, and which are increasing in the conditions of working remotely in comparison with the reality before the pandemic according to the studied sample.

Table 1

Changes in the characteristics of the organizational climate in the conditions of remote work in comparison with the present one (%)

	Kind	Generous	Demanding	Transparent	Loyal	Callous	Disconnected	Supportive	Political
Increased	51	46	39	40	45	26	29	52	30
Same	43	45	46	49	46	57	45	37	57
Decreased	6	9	15	11	9	17	26	11	13

Source: <https://www.qualtrics.com/m/assets/wp-content/uploads/2020/08/Qualtrics-Quartz-Results.pdf>. Retrieved: 10.04.2021.

There is a certain contradiction here: the declared growing atmosphere of support and kindness, the tendency towards more tolerance, the increased sense of loyalty and openness are combined with the perceived increase of organizational politics, distancing, and lack of empathy and sensitivity.

A team from Sloan School of Management at the Massachusetts Institute of Technology (Sloan/MIT) has been using a methodology developed there for several years (MIT SMR/ Glassdoor Culture 500), covering more than 1.4 million employee reviews in 500 leading companies to analyze various aspects of cultures. In a study with the same methodology from the end of 2020, devoted to the impact of the pandemic and distance work, there are some interesting results as well, although only within the US (Sull, 2020)

One of the outstanding phenomena caught in this study is the relatively sharp increase in the positive judgement of employees concerning the amount of communications and openness of managers in dealing with the pandemic crisis after the start of WFH compared to previous times, which we could call normal. The respondents are much more critical when it comes to agility and management efficiency after the start of the new schemes of work. The “accusations” are mainly in areas such as: bureaucracy (almost 40% negative assessment), paperwork (in the conditions of new technologies, this means mainly the number and organization of e-mails and messages), slow reaction to changes, risk aversion, uncertain priorities, quantity and quality of meetings, impaired sense of community (big-company feel).

Microsoft is also reporting results from an interesting survey (TechRepublic, 2021), which includes interviews with more than 30,000 employees from 31 countries, combined with an analysis of billions of e-mails, messages, meetings in the online platforms, and more. These studies show that the flexibility and agility associated with new forms of WFH are positively assessed by employees and obviously, at least some of these forms will be maintained in the future. The conclusion is confirmed that about $\frac{3}{4}$ of the people want the flexible mixed forms, including remote work, to be kept in some form after the normalization of the situation. Among the positive changes caused by the massive increase of WFH, the interviewees point out the increased chance and opportunities they have to pay more attention to their relatives and partners and to communicate with them in general. However, over 67% of them declare that they want more live communication with their colleagues in parallel with the opportunities for remote work.

At the same time, the study identifies a problem with the blurring of the boundaries between professional and personal spaces and a lack of transition between them (during travel to and from work, for example). The significant increase in the duration of online meetings compared to conventional ones combined with the presence of unscheduled online meetings led to a twofold increase in the time spent in meetings. Chat messages, in general, have increased by 45%, and those received and sent during non-working hours – by 42%. Aside from the issue of meetings on some platforms such as Teams and Zoom, 66% of people say they create and read many more written documents online instead of having more basic and faster forms of live conversations. In 2020 and 2021, the number of e-mails sent was many billions more (40 billion only through one of Microsoft’s mail platforms) compared to similar periods last year. Over the past one-year period, the work on digital documents has increased by over 60%.

These are probably just some of the reasons why 54% of the respondents in this study think that they are overworked, and almost 40% – exhausted by the new methods of communication and work. The tension of the imperativeness and urgency of virtual meetings,

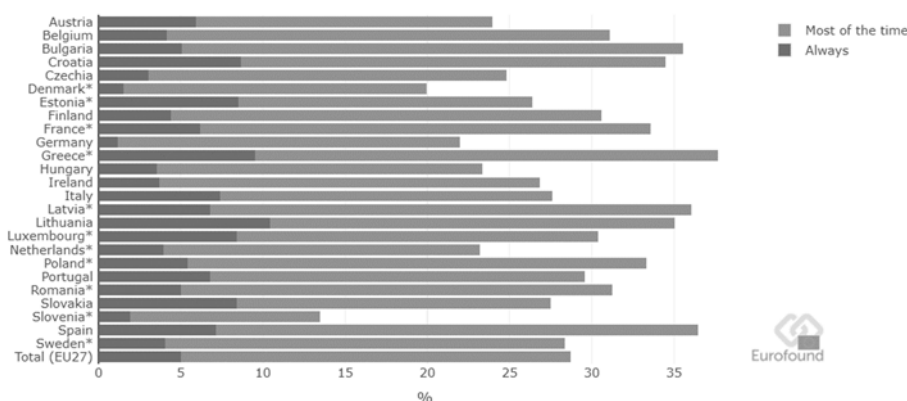
combined with the lack of the typical subtle social signs and body language, makes communication and interpretation of meanings and intentions more painful. To compensate for the lack of these natural contextual elements of live communication, chat in small groups or pairs increases significantly. It also contributes to feelings of fatigue, anxiety, and exclusion at least from the “big picture”. One spends more time with colleagues with whom one works in direct cooperation, but much less time with one’s wider communication networks. At the end of the day, this is a threat to creativity, innovation, and opportunities for good performance. The hardest hit is for the new employees with less than a year of experience, for generation Z (18-25 years), and for those who live alone.

Some data are beginning to show (<https://Employees under 35 prefer office life to remote working | ZDNet>) that younger employees are flocking back to the office. But why? Many Millennials and Gen Z-s want to be promoted, want to belong to a community, and want to be mentored. They very well know they need to be in the office to reap those benefits, even if they want to use WFH. In addition, they are unsure of the expectations around work-from-home if there is potentially conflicting information from policy, their co-workers, and management. They, therefore, cannot take advantage of telecommuting as much as they would like to. In other words, there is a huge disconnect in expectations around work-from-home for these specific age groups.

Another survey offers more or less similar conclusions when it comes to fatigue and emotional drainage while WFH during the Covid-19 pandemic. Figures 1, 2 and 3 can demonstrate some aspects of the problem. A considerable amount of the respondents report that at the end of the day, they are too exhausted to do something else at home. Many of them feel deprived of free time, and not a small fraction of them report that they feel *emotionally* (not mentally or physically) drained by the remote type of work.

Figure 1

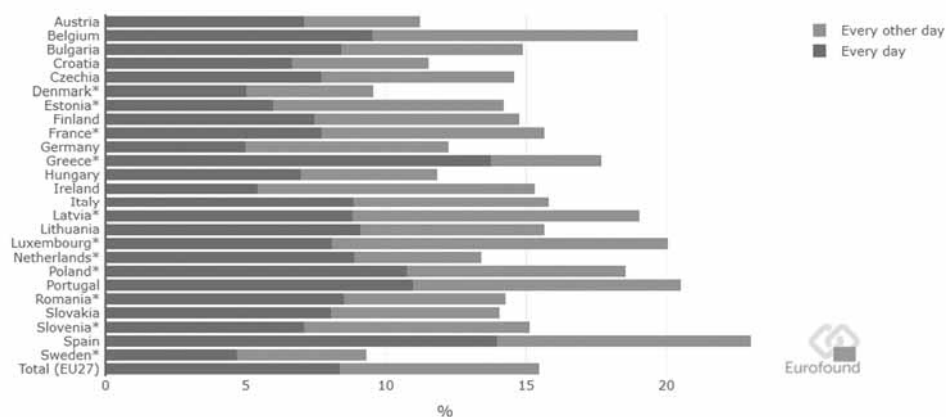
How often in the last two weeks you have felt too tired after work to do some household jobs



Source: Eurofound (2020), Living, working and COVID-19 dataset, Dublin, <http://eurofound.link/covid19data> (Some countries excluded due to insufficient data; (*) – low statistical reliability, Retrieved: 14.04.2021.

Figure 2

Over the last two weeks, how often have you worked in your free time in order to meet work demands

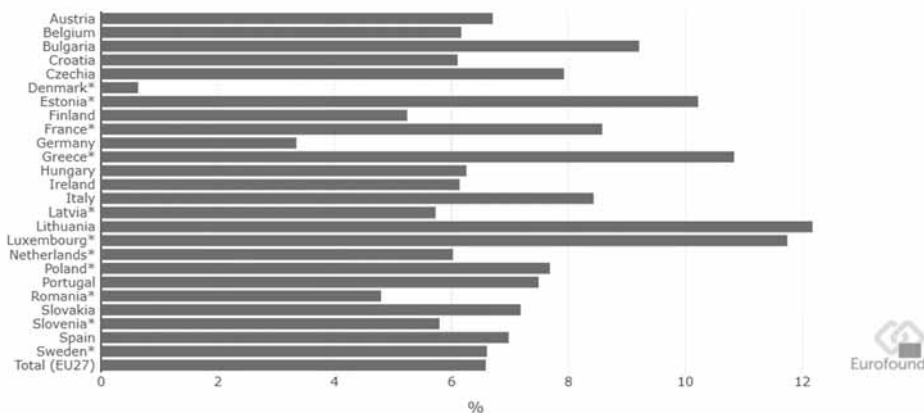


* low statistical reliability, Retrieved: 14.04.2021.

Source: Eurofound (2020), *Living, working and COVID-19 dataset*, Dublin, <http://eurofound.link/covid19data> (some countries excluded due to insufficient data).

Figure 3

You feel emotionally drained by work



* low statistical reliability, Retrieved: 14.04.2021.

Source: Eurofound (2020), *Living, working and COVID-19 dataset*, Dublin, <http://eurofound.link/covid19data> (Some countries excluded due to insufficient data).

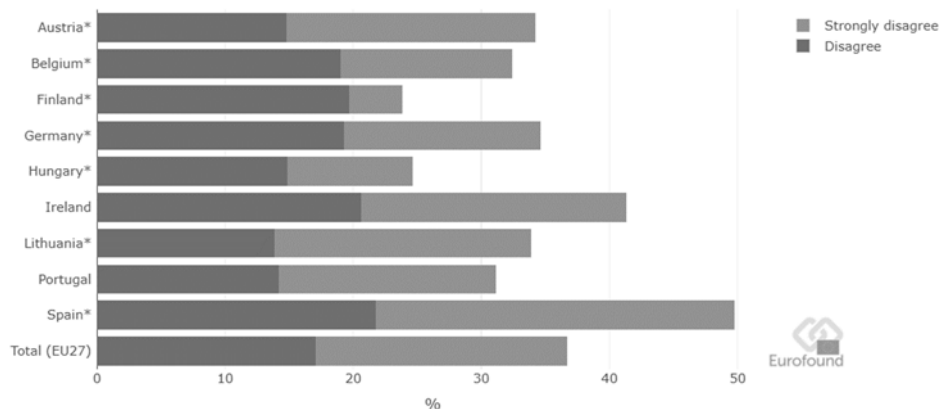
Companies are offering more and more remote positions (5 times more in a year than in the previous year in LinkedIn), but few of them take real and consistent care and investment in the conditions for such work – one in every ten employees does not have good enough internet at home, 42% feel the lack of basic office equipment and less than half of the workers working from home worldwide have received at least partial reimbursement for the costs they

have incurred for this purpose. It is this lack of support that may be at the root of the fact that 41% of employees report intentions to quit within a year (54% of those in Generation Z).

One of the clear problems is purely technological and is related to the increase of bureaucracy, the amount of written communication associated with at least to some extent to the increased tendency of risk aversion. The hardware aspects of online connectivity and access and connection quality of internet platforms and the internet itself are also not to be neglected, including in terms of the employer's commitment to providing material conditions for WFH. A considerable amount of employees even haven't received the necessary basic technological support from their employers (Figure 4), which not only affects the quality of work, but harms culture as well. There is no clarity and certainty in other pragmatic technological management problems, such as the legal regulation of the new remote working methods, the control over the participation and the contribution (where such control is necessary), etc.

Figure 4

My employer provided me with all necessary equipment to work from home during the Covid-19 pandemic



* low statistical reliability, Retrieved: 14.04.2021.

Source: Eurofound (2020), *Living, working and COVID-19 dataset*, Dublin, <http://eurofound.link/covid19data> (some countries excluded due to insufficient data).

The changes look different through the eyes of the employer and the staff. It can be expected that in the short term, both parties will spontaneously tend to be positive about WFH, albeit for many different reasons – employers due to reduced office maintenance costs and employees due to increased degrees of freedom of choice of time and method of work and the absence of commuting to and from work. (Interestingly, 85% of respondents in the Qualtrix-Quarz study do not feel anxious to return to their traditional ways of travelling to the office.)

The industry specifics have also had and still have an impact not only on the typical cultural dominants (the worlds of the software industry and the pharmaceutical company are difficult to compare), but also on the technical possibilities, limits, and forms of application of remote

methods of work and communication. This industry framework also includes the fact that different industries suffer to a very different degree from the effects of pandemics and lockdowns. Call centres may not feel much pressure, unlike tourism, restaurants, air transport, office buildings, and more, as well as their suppliers and users along the value chain.

With a slightly more complex, in-depth, and long-term perspective, however, these processes of transition to digitalization and distant forms of work and communication cannot but be associated with significant issues in terms of psychology, culture, and management.

According to some studies (Stahl, 2020), no less than 70% of employees who work entirely or partially from home experience symptoms of burnout, which has serious consequences for both their health and productivity. It is good to remember that burnout does not mean just boredom or fatigue, but has been shown to be associated with many negative physical and mental conditions such as: high blood pressure, heart disease, obesity, weakened immune system, anxiety, depression, decreased cognitive capacity, Alzheimer, etc. There is also evidence of another additional important effect resulting from forced social isolation – loneliness. Studies show that if overweight reduces life expectancy by an average of about 20%, alcohol use – by 30%, brain-somatic reactions to feelings of exclusion and loneliness can cause up to 70% negative effect on the same indicator (Petrie, 2018).

Working from home can be detrimental as well due to the inability to draw a clear line between working time and other activities. Employees report an increased number of working hours – an average of three – under the new conditions (Davies, 2020). The classic working conditions presuppose working and domestic domains of life with a quite clear boundary between them. Blurring this boundary has negative consequences on the sense of well-being and commitment (Ashforth, 2000).

In fact, here we are touching on a phenomenon that is well known to all those employed in the academic field (especially doctoral students), and which few employees in other fields have experienced before the introduction of mass distance working. The freedom to choose the time and method of work may seem very attractive, but like any freedom, it can bring unbearable and sometimes unexpected burdens. This is due to the lack of clear boundaries of working hours and institutional regulation of the process, reflecting in constant burdening of the psyche with guilt for something unfinished, for insufficient activity, for “wasted” time, etc.

Many of us would bet that in some cases working without colleagues around can seem like a real holiday. But in many situations (for example, if something goes wrong with a given task, a colleague leaving or being fired, the insufficient ability of superiors to lead well online, restructuring, to give a few examples), the employee begins to feel painful isolation, confusion, and lack of support. According to Cachopo (UCLA), these feelings of isolation and relative loneliness can affect a person’s global perceptions of the world, make him feel threatened, reduce his trust in others, and activate defence mechanisms (Cacioppo, 2014). Perhaps this is at least one of the factors leading to the trend of increasing the burden of electronic, written communication.

The increased feeling of burnout is not limited to the emotional response and negative feelings experienced by the individual. There are changes in the anatomy and functioning of the brain associated with impaired cognitive abilities (the capacity to think, learn and pay attention) and in the neuroendocrine systems (serotonin and adrenaline cycles). Increased levels of stress include a “survival” mode that damages our ambitions, responsibility, creativity, inspiration, and so on.

Even without the symptoms of burnout, the socio-psychological environment itself is extremely challenging to mental health in general, and this is a key input factor from the environment that cannot be bypassed when considering the micro-level picture. These are general experiences of isolation, fear for oneself and loved ones, frustration, anxiety, interpersonal tensions, and damaged relationships in and out of the family context due to forced confinement, etc.

Outside of these individual psychological effects, but in direct connection with them, the new WFH practices have very important cultural and motivational dimensions. As we pointed out at the beginning, there are significant differences in terms of industries and types of activity, the status quo before the pandemic changes, etc. But in general, the non-cognitive and emotional factors of any work with people and of any management and leadership, neither disappear with the new conditions, nor their importance decreases.

In general, there is no organization or team without culture. It would be at least naive to perceive man and the relations between people – power-based, collegial, and personal, as relationships between avatars and algorithms or as a simple division of labour, organization, coordination, planning, and so on. This would mean going back at least 150 years to our understanding of what management, people management, and working with people mean. The various soft factors have neither disappeared nor can be easily translated into the language of virtual communication and WFH. The bigger part of the fruitful life of man passes in one or more organizations, i.e. work cannot be perceived as a means of subsistence, it is life, a very large part of it. At the same time, it is empirically clear to everyone, and cognitive-neuroscientific research shows it eloquently, that a massive part of our decisions and preferences, on the basis of which our relationships are built, are non-cognitive at their core. They are primarily emotional and are related to such vague concepts as sense, artistry, non-verbal communication, tact, “feeling” of the other person and his goals, intentions, motives, essence. It is on this basis that a significant part of the phenomenon we call leadership is formed, and it has a lot to do with trust, cohesion, self-identification and a sense of togetherness in a team, and with a significant share of motivation and motivational tools. In practice, a huge part of our social dynamics outside of organizations, in our personal lives, is based on the same.

Let us remind that organizational culture can be thought of as a set of values that are common to a group at a given time; values that are expressed in language, norms, artefacts, rituals, conventional wisdom, organizational climate, etc. The synchronicity of value interpretations and hierarchies builds the very fabric of the community, provides for a (better or worse) orchestrated internal integration and external adaptation, builds a unique organizational “parallel reality”. The latter cannot but be influenced from outside, from its macro-environment and its values (say, national-cultural, professional, or sectoral), but at the end,

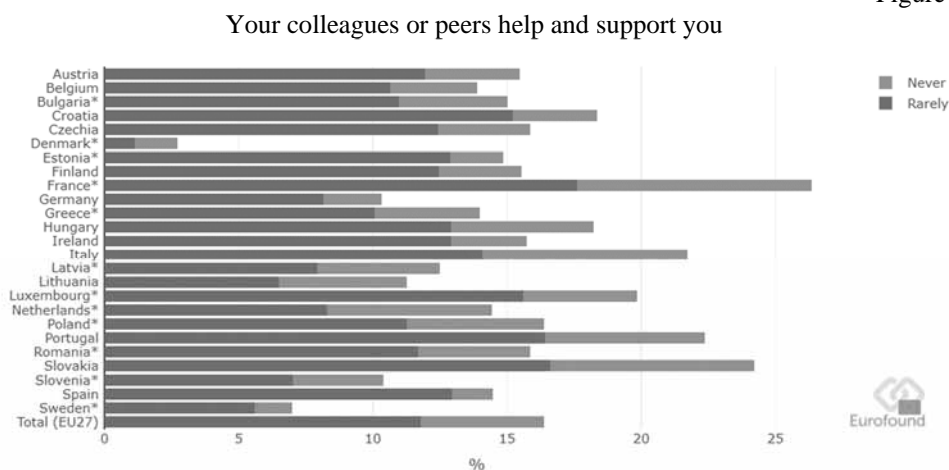
each organization is a small world, a small “bubble” of reality against the background of everything around. In this reality – no matter how different or unique is each person – there is a certain consonance in the ways of thinking and evaluation, in the semantic interpretations of objects and events, in behaviours, reactions, etc. All this is achieved in terms of cognitive, meaningful, subject to consistent logical and analytical elements, but twice as much in terms of non-cognitive, emotionally based, and unconscious ones. Just like in all other, non-organizational aspects of our lives and our relationships with other people. Add to this the seemingly underestimated fact that any leadership, whether charismatic or not, inevitably implies a motivational, emotional, and value charge that cannot be isolated from culture. Culture cannot be managed in the literal sense of the word, but conditionally speaking, leadership could also be defined as the management of culture and management through culture.

The simple physical encounter with people in the office, the joint lunch, and the small talk around the coffee machine and in the office corridors may seem insignificant and irrelevant to the successful joint work, but this is how people get to know each other and build social capital. In this way, trust is built, the invisible threads of the sense of “we” are created, areas of common interest are opened, ideas are generated and conversations are started. It is hardly necessary to go back more than a century and recall the dawn of scientific management when it was scientifically established that even simple cooperation (work in the mere physical presence of other workers, without division of labour) significantly increases productivity compared to individual forms of organization.

Proven effective motivational practices related to the recognition of abilities and contribution, the impact on the individual perceptions of the content of work such as importance and interest, teamwork and support, etc., are realized not only and not so much in an official or institutionalized form, but many of them are often the product of elementary but immediate human communication with all its verbal and nonverbal attributes.

Some of the phenomenological components of organizational culture, such as the specifics of spoken organizational or group language (like speech, in combination with all its prosodic elements, usually loaded with a huge amount of semantic context), rituals, norms, artefacts, and organizational climate, for example, may not work remotely or may not function properly. What we call “atmosphere” in the office is absent, and with it – a significant part of the sense of community and identification with the organization or the team coming along the cultural and motivational charge of this atmosphere. Under such conditions, the arsenal of any leadership is severely deprived of its typical weapons, incl. the charismatic elements. The feeling of distance and, in many cases – isolation – cannot but increase. The borders and the functioning of the informal structures and the established informal communication networks have been violated. All this reflects in reduced levels of trust. In connection with the above said, there is a growing feeling among employees that they lack enough support from colleagues and peers (Figure 5).

Figure 5



* low statistical reliability, Retrieved: 14.04.2021.

Source: Eurofound (2020), Living, working and COVID-19 dataset, Dublin, <http://eurofound.link/covid19data> (some countries excluded due to insufficient data).

If we allow ourselves in just one paragraph, in addition to what has been said, to get rid of the analytical approach and use a maximum level of concreteness and some imagery, we will agree that each of us has seen (not personally, but with friends, of course) how kitchens, living rooms and bedrooms, and sometimes closets and glazed balconies, are tortured to be turned into work corners. Very few people have the opportunity to set up one or two office rooms or libraries in their homes. The internet is not always and not everywhere good enough. Households with more members either have to share a computer or everyone has their own, usually living together with plates and cups – washed or not – on the kitchen or living room table. It is impractical to expect that at any given time these “workstations” and their associated cables, documents, and folders will be cleared and collected by the next business day, especially since e-mails and messages arrive outside of business hours too, so very often you can have dinner on your knees in front of the TV, and the atmosphere is not suitable for meetings with friends. In many cases, children go or run around in the process of their remote learning (in many cases only formally) or use computers – sometimes their own, but in most cases their parents’ ones while at the same time these parents are expected to be working remotely as well. Online meetings, e-mails, and chats are significantly more compared with the classic forms of work. Meetings which are sometimes exhaustingly long and poorly structured. It is not uncommon for parents from one or adjoining rooms to attend team meetings in parallel, while the children are online, the dog barks at someone outside, the cat crosses the keyboard to optimize her route, and the food burns in the furnace. If there are preschool kids around, they may not always be sent to a kindergarten due to the closure of the latter or for some other reason, so there may be diapers in the workplace and the sound in the background may be by several decibels higher. There is no one to keep track of time and method of work, but this means not only freedom but also relentless tension from accumulating tasks, unread letters, approaching deadlines and unanswered messages. There

is a growing sense of isolation and the suspicion that a person is missing something important in his or her office world, something, which may be happening to or between colleagues and the organization as a whole. This brings additional annoyance to being forcibly closed between four walls with your otherwise loved ones. There is no rhythm and dynamic stereotype of activities to help. The boundaries between office and personal realities are seriously blurred, from which women suffer more because they are still the main drivers of household activities. As we already saw, Generation Z-s are another group massively hit by the new work realities.

Organizational culture is associated only to a certain extent with the technological manner of work and communication, i.e. with the norms regulating the organization of work, planning, coordination, control, etc. It largely remains in the semi-conscious and semi-visible elements of interaction and togetherness.

The culture of a company goes beyond setting and preaching its vision, mission, and goals. How these missions and goals are visualized and internalized by every employee and how they are met, is where company culture comes in. Unlike a business' vision and goals, which are written down and reminded frequently, the culture of a company is not something to be simply decided, set, or noted down and preached. It is something that develops in the course of work, as the employees integrate and develop a team spirit. If the vision and mission of a company is the starting point, then its culture is the journey which is embarked on by everyone who makes the company what it is. It is something that is cultivated along the way rather than something that is adapted.

Once this culture is formed, there is a need to keep it fostered, because it is this culture that will act, at the end of the day, as the driving force for the employees to visualize the growth of the organization and to act in accordance with that vision. Organizational culture drives employees to reach goals that they see as a team for the company, gives them a sense of identity and belongingness, creates faith in them to work harder to cope with problems and crises. Culture also has a great impact on keeping the zest and enthusiasm of working for a collective cause. As a result, all of these points mentioned above will, in-turn, foster team building, cooperation, productivity, and therefore- job satisfaction.

The issue is that WFH model cannot but negatively affect all these cultural functions.

In the first place, distance work is inevitably curbing interactions. Face-to-face interaction can never be on par with the virtual one. When employees work from home, the maximum interaction they have with their co-workers is via mails, calls and online meetings. Creating stronger bonds with co-workers is crucial for any group activity, but forming such bonds requires physical presence, which is ruled out through occasional interactions on screen. Studies conducted by a Harvard Business School team (Worline, 2017). in the field of emotional intelligence show that companies with stronger co-worker bonds show signs of increased job satisfaction and, therefore, productivity and growth. Sharing a strong relationship with co-workers also helps foster team spirit, which remains blurred in the WFH as good team-building almost always requires us to be physically present. This interaction also plays an imperative role in developing trust among co-workers, which is another extremely important quality required to build a positive team that works towards the success of the organization.

Hand-in-hand with the need for interaction goes the issue of loyalty. Without active interactions, how does an employee develop a sense of loyalty, not only towards his/her co-workers but towards the business as a whole? This loyalty can act as a driving force to do better for the growth of a company. A study (Comparably, 2021) shows the importance of loyalty in work culture and the data in this survey essentially show that workers express a sense of loyalty towards their co-workers, relatively more than they do towards their employer/boss. This means that they are ready to help their co-workers in times of difficulties, which could reduce stress levels, encourage team cooperation during crises, and therefore increase a sense of belonging and job satisfaction as a whole. This sense of belonging, unfortunately, can't be instilled successfully enough when employees work from home.

The above is also true when it comes to motivational dimensions of culture. Another important aspect of company culture is being driven as a team towards a given objective. This is initially developed with a variety of team-building exercises, that can't conventionally be done virtually. Such motivational team spirit is specifically tested in times of losses and crises when the vision and culture of the company are prioritized and employees team up to work harder to meet the necessary goals. Communicating virtually from remote places does little to help develop this team bond. Motivation in the WFH conditions often depends on the worker, self-motivation is key to the successful accomplishment of this mode of work, being driven as a team is not prioritized thereby it is affecting company's culture, which otherwise thrives on employees coming together and keeping the life of their company alive, together.

In many cases, distance work leads to compromising of work culture. A well-organized office paves the way to a positive work ethic because a good conventional office layout sets a professional mindset, fosters strong team skills and team self-control, encourages competition, develops a positive work ethic at least because when an employee sees others working hard, he or she is motivated to do so as well, promotes punctuality (as opposed to the distant working which thrives on flexibility).

A study (Grenny, 2017) has found that remote workers feel isolated, shunned, and left out. Be it the lack of falling into work culture, or the lack of interaction among co-workers, which builds trust and a sense of belongingness– remote workers reported they were facing anxiety from feeling cut off. This takes a toll on the mental health of employees who work from home and does no good to the overall development of the company, or its culture.

There is a difference in the understanding of the processes of transformation from office work to working at home and from direct to remote communication in already established cultures in comparison with those that are being created under the new conditions. In all cases, however, remote forms of work and meetings bring noticeable and generally negative changes and challenges both to culture and in the field of motivation and leadership. These changes are combined with the increased feelings of burnout, fatigue and stress, experiences of isolation, fear for oneself and one's loved ones, frustration, anxiety, interpersonal tensions, and damaged relationships.

Realistically and pragmatically, there is no room for euphoria about working from home, neither in terms of efficiency and effectiveness nor in terms of individual motivation and satisfaction. On the other hand, we can expect with a very high degree of confidence that the

“old normality” is irrevocably obsolete and the future will not return us to the classic pre-Covid office ways of work. There is both economical and pragmatic-organizational sense (and trend) that the future that awaits us must include more forms and a given share of distance work at the expense of the classic one, but without the disappearance or underestimation of the latter. Organizational culture does not tolerate a vacuum, it arises and develops organically and spontaneously, regardless of whether someone has taken it into account and tried to influence it. This means that the environment created by the pandemic and the forced movement towards new forms of work will inevitably affect it, and the more focused and meaningfully the management approaches the issue, the greater the chances of successful cultural adaptation. The same is true for the arsenal of leadership and motivational policies and practices.

Many of the problems mentioned above can be solved comparatively well while satisfying the desire for more remote work on behalf of employers and employees. This can be done by moving towards more flexible mixed forms of employment, which imply a partial physical presence in the office combined with work from home in proportions that depend on the type of activity, the organizational specifics, and the surrounding cultural dominants. In any case, however, it seems imperative that the management focus its attention and efforts on the following.

- In the first place, there is a need to show sensitivity and understanding to the needs and concerns of employees and to provoke a sense of care and support in general in them.
- The above presupposes both awareness of purely technical problems when working at home (hardware, internet connectivity, etc.) and regulation of the technological dimensions of the communication process (number, frequency, duration, and time of meetings and written work). It is necessary to regulate the volume and the mode of written communication.
- Finding a specific form of realization of flexibility and combining attendance days and hours with work online. It is necessary to build a structure of norms for work and communication (for example, regarding the meetings in Teams, Zoom, the modes of sending e-mails, etc.). This can be done in parallel with the introduction of new cultural norms and rituals or adaptation of existing ones and it is not always necessary to be fully formalized or administered but to be achieved mainly by personal example.
- In cultures and motivational practices which the pandemic has found in good condition, it is necessary to consider how their success can be continued and strengthened in the conditions of the increased flexibility of work locations and the new ways of communication. The elements providing for physical presence in the work schedule will help for this. For the others, the new situation is a good opportunity to build new cultures, motivational practices, and leadership. The idea is to maintain or develop an understanding of a common goal, value priorities, meaning, inclusion, and a sense of community.
- The importance of communication is growing not so much in terms of duration but as a means of maintaining a sense of inclusion and maintaining and increasing levels of trust. There is also a need to focus on communication outside the narrow framework of working

(design, functional and other) teams and finding forms of effective interaction in a broader framework, e.g. of the organization as a whole.

- Another key cultural moment in the current situation is the emphasized and increased need for openness.

It should not be forgotten that the importance of culture, motivation, and leadership does not decrease, but increases with the new work schemes based on WFH. Efforts are basically limited to how to “translate” them into the language of the combination of presence and distance in each specific organizational and cultural situation – a task that has possible solutions, provided that there is an awareness of the existence of the task itself.

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THE PERFORMANCE OF HEDGE FUND INDUSTRY DURING THE COVID-19 CRISIS – THEORETICAL CHARACTERISTICS AND EMPIRICAL ASPECTS²

The study reveals that the COVID-19 crisis has had a strong but one-off negative impact on the hedge fund industry. It also shows that during the new coronavirus pandemic, the main components of the hedge fund industry achieved only partially their main investment goal, i.e. they as a whole provided a hedge of the investment risk but did not produce higher than the market return in the conditions of a growing capital market. In this situation, due to the relatively stable M&A market, the Event-Driven Risk Arbitrage strategy was undoubtedly most successful, followed by the Emerging Markets, the Global Macro and the Long/Short Equity strategies. The worst performance was reported for the Fixed Income Arbitrage strategy due to the currently overvalued bond markets and to the expectations for higher inflation rates in the countries with developed capital markets.

Keywords: hedge funds; investment strategies of hedge funds; portfolio performance; COVID-19

JEL: G11; G15; G23

Introduction

Hedge funds are among the most popular collective investment schemes. This is largely due to the high levels of secrecy associated with their activities. Another reason is the great freedom of their investment operations, which makes them significantly different from the other types of investment funds. Hedge funds are also popular because they often are perceived as subjects whose investment activities produce turbulences on the global financial markets. The hedge fund industry also concentrates huge financial resources. According to BarclayHedge, by the end of the Q4 of 2020, hedge funds and the associated Commodity Trading Advisor funds were managing assets worth more than \$4.128 trillion (BarclayHedge, 2021). This means that the great economic power of these financial institutions should not be ignored.

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The COVID-19 crisis hit the world economy in an unprecedented way. According to the International Monetary Fund, in 2020, the world's gross domestic product is expected to shrink by 4.4% (IMF, 2021), and the GDP decrease of the world's leading economies to surpass even the decline after the global financial crisis of 2008. Under these conditions, of all major economies, only China reported annual growth of 6.5% (Reuters, 2021).

The dynamic processes in the global economy have inevitably caused strong turbulence on the global financial markets. During the second half of March 2020, some leading indices such as S&P500, FTSE 100 and NIKKEI 225 declined over 30% of their highest values recorded since the beginning of the year and for the European CAC40 and DAX30 the decline was over 38%. A rapid recovery followed, with capital markets in the United States and Japan growing by more than 75% by early March 2021. Even the SSE Composite index of China's capital market, which was affected less by the crisis, registered a decline of 10.97% from 03 January to 20 March 2020, followed by an increase of 30.57% by 25 February 2021. Moreover, on 20 April 2020, the crude oil futures hit negative values (Reuters, 2020) and then rose to over 60 USD per barrel by the end of February 2021. In August 2020, the price of gold reached a historic high of more than 2000 USD per ounce (BBC, 2020). At the beginning of 2021, however, gold registered its weakest start of the year for a period of 30 years (Telegraph, 2021). Such volatile markets are a challenge for every portfolio manager and every investor. However, they are an excellent opportunity to study how managers in the hedge fund industry have managed their portfolios under the described conditions, whether their management has been effective and whether it has achieved its main goals. Therefore, the object of the study is the portfolio management of hedge funds in the conditions of COVID-19, and its subject are the quantitative tools for portfolio performance evaluation. The aim of the study is to conduct a systematic analysis of hedge funds performance in the conditions of COVID-19 and to determine whether, in such conditions, they achieve their main investment goal.

1. The Hedge Fund Industry and the COVID-19 Crisis

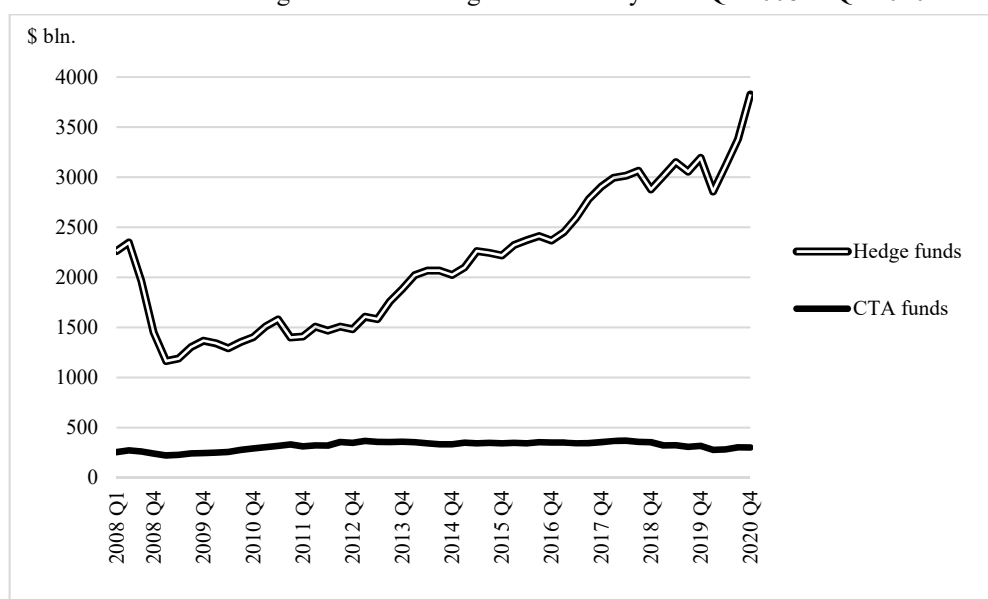
Unlike the last crisis, which seriously affected the global financial markets and the world economy in the period 2008-2009, the current COVID-19 crisis occurred first as a health phenomenon caused by the SARS-CoV-2 coronavirus. The first cases of people infected with it were reported by the scientific community at the beginning of December 2019 in the town of Wuhan, China (Huang, et al., 2020). However, the health authorities in the Chinese city officially announced the new infection much later – on December 31 of the same year (Reuters, 2019). By then, the global economy and financial markets had not been affected by the negative processes associated with the infection. However, this date can be accepted as the official beginning of the global crisis caused by COVID-19.

The official start of the crisis caused by the new coronavirus at the very end of the year means that it did not affect the performance of the hedge fund industry in 2019. Quite the reverse, according to the information shown in Figure 1 (BarclayHedge, 2021), the hedge fund industry has been growing throughout 2019. Together with the CTA funds, at the end of the first quarter of the year, they managed \$3.334 trillion of assets. This is an increase of 3.12%

compared to the end of 2018, which offsets the slight decline of the volume of assets they managed in the Q3 and the Q4 of that year. The hedge fund industry ended 2019 with \$3.512 trillion of assets, which is a growth of 8.64% compared to the beginning of the year and a total growth of 153.33% compared to the first quarter of 2009.

The impact of the new coronavirus on the financial markets was felt in the first quarter of 2020. At the end of February and the beginning of March, the global capital markets were registered their biggest declines since the global financial crisis from 2008. Consequently, at the end of March 2020, the assets managed by hedge funds and CTA funds fell by 10.74% to \$3.135 trillion. The unwinding of the healthcare aspects of the crisis, together with the measures undertaken by most governments and central banks to support their economies, are gradually soothing the financial markets and they, despite some minor exceptions in terms of commodity exchange shocks, reported growth by the end of 2020. The assets managed by the hedge fund industry skyrocketed to \$3.366 trillion in the Q2 and \$ 3.683 trillion in the Q3 of 2020. This means that at some time between July and September of the same year, the hedge funds completely offset the losses they had incurred due to the COVID-19 crisis. In the Q4 of 2020, the industry grew by a further 13.22% compared to the previous quarter, and the growth continued even in the first months of 2021 (Hedge Fund Research, 2021). This means that the COVID-19 crisis creates a one-off negative shock for the hedge funds from which they are recovering rapidly.

Figure 1
Assets under management in the hedge fund industry from Q1 2008 to Q4 2020



Source: BarclayHedge.com.

However, the dynamics of the assets under management provides only a general overview of hedge fund industry performance during the COVID-19 crisis. In fact, the analysis of how

hedge funds perform during the current crisis is more complex and much more detailed due to several reasons. First of all, the hedge fund industry is quite fragmented. It comprises many players that follow various investment strategies. This is why hedge funds are not analysed in terms of their risk profile, as is the case with traditional investment funds but are grouped and analysed in terms of their investment strategies. Secondly, regardless of their type and investment strategy, hedge funds have the common investment goal to achieve the highest possible return regardless of the conditions in the financial markets (Jaeger, 2003, pp. 3-4), i.e. the effectiveness of their portfolio management is a key factor for them. This problem is especially important in the conditions of financial market turmoil such as the one caused by COVID-19. Therefore, from the point of view of financial theory and investment practice, the analysis of the efficiency and quality of investment management in the different parts of the hedge funds industry during the COVID-19 crisis becomes even more interesting.

2. Characteristics of the Hedge Funds Strategies

Currently, there are many different and sometimes even contradictory classifications of the investment approaches applied by the hedge funds. Such classifications are proposed by authors such as Lhabitant (Lhabitant, 2006, pp. 159-399), Stefanini (Stefanini, 2006, pp. 21-277) and Anson (Anson, 2006, p. 139). Information companies such as BarclayHedge (BarclayHedge, 2021), Eurekahedge (Eurekahedge, 2021) and Hedge Fund Research (Hedge Fund Research, 2021) also use their own definitions of hedge fund investment strategies. However, the most common and frequently used classification is that proposed by Credit Suisse (Credit Suisse, 2021). Its main distinguishing feature and advantage are that it is not as detailed as the classifications of BarclayHedge and Hedge Fund Research and at the same time, it is not as concise as that of Eurekahedge. According to Credit Suisse, hedge funds are classified according to the following nine strategies:

First. Long/Short Equity is a strategy based on the principles formulated by Karl Karsten in 1931 (Karsten, 1931). It combines long positions in equity instruments, the value of which is expected to increase with short positions in those whose value will decrease. This multiplies the return and reduces investment risk due to the negative correlation between the different parts of the portfolio, which is artificially created through short sales.

Second. The Equity Market Neutral strategy was created and applied for the first time in the period 1979-1980 by Edward Thorp. Here the portfolio is created with zero net market or zero net beta exposure. This makes the portfolio neutral to the systematic risk factor, but retains its ability to extract high returns.

Third. Event-Driven is a set of investment strategies related to specific corporate or market events, such as mergers, acquisitions and financial distress, etc. With proper management of regulatory risks, the strategy provides an opportunity for very high and almost riskless returns.

Fourth. Fixed-Income Arbitrage is currently the strategy under which most of the assets in the hedge fund industry are managed (BarclayHedge, 2021). Here the hedge funds make arbitrage among different debt instruments, which allows the spread in their yield to be fully

hedged. The main drawback of the strategy is its highly leveraged nature which could lead to large losses or defaults like this of Long Term Capital Management L.P. in 1998.

Fifth. Convertible Arbitrage is a strategy that exploits the fact that convertible securities are often traded below their intrinsic value. The strategy is usually implemented with short positions in common stocks and long positions in convertible bonds of the same issuer. Due to its complexity, the strategy is not very popular.

Sixth. Global Macro was applied for the first time in 1980 by Julian Robertson in his Tiger Fund (Rohrer, 1986). Here the investment operations are global and they are motivated by the identified market or economic anomalies. The strategy is very attractive due to its global diversification of risk, high return and access to the cheapest possible sources of financing for its implementation.

Seventh. Emerging Markets is not a separate investment approach. Here hedge funds make their investments only in economies with financial markets identified as emerging. The strategy provides high returns, but at the same time, is characterised by high levels of investment, credit, and political risk that are typical for the emerging markets in Asia, South America and Eastern Europe.

Eighth. Managed Futures, also referred to as Commodity Trading Advisor by the legal definition of the funds that apply it (Electronic Code of Federal Regulations, 2021) is not a hedge fund strategy but is referred to as a strategy because of the fact that the CTA funds have all the functional and financial characteristics of hedge funds. Under this strategy, the CTA funds buy or sell futures contracts on different exchange-traded commodities. This allows them to diversify the risk among many assets whose value is affected by completely different fundamental factors.

Ninth. Multi-strategy is an investment approach where the hedge funds apply not one but several investment strategies. This increases the sources of return and allows a double reduction of investment risk.

3. Methodology and Data

As it was mentioned above, the main goal of hedge funds is to achieve a positive return regardless of whether markets are rising or falling, i.e. they must have zero sensitivity to the systematic risk factor. Another feature of the investment policy of hedge funds is related to the way they make their revenues. Unlike traditional investment funds, hedge funds generate most of their income from the fees they charge on the growth in their net asset value. Thus the hedge fund managers are motivated not only to achieve high returns but also to do it relatively quickly, i.e. their portfolio management is predominantly short-term and dynamic.

These characteristics severely constrain the possibilities to evaluate the portfolio performance of hedge funds using some traditional tools, such as the Treynor ratio (Treynor, 1965), the Jensen model (Jensen, 1967), its derivative appraisal ratio (Treynor & Black, 1973), the model of Treynor and Mazuy (Treynor & Mazuy, 1966) and the Fama model (Fama, 1972). They assess the portfolio performance using systematic risk, CAPM, and

related to them concepts. Therefore, when used to evaluate hedge funds, they would provide misleading results. In contrast, hedge funds performance can easily be evaluated using the Sharpe ratio (Sharpe, 1966), the arithmetic tracking error from equation 1 and Sharpe's information ratio (Jorion, 2007, p. 373):

$$TE_A = \frac{\sum_{t=1}^T (r_{p,t} - r_{b,t})}{T-1}, \quad (1)$$

$$I = \frac{r_p - r_b}{\sigma_{r_p - r_b}}, \quad (2)$$

where: TE_A is the arithmetic tracking error. $r_{p,t}$ is the portfolio return at time t ; $r_{b,t}$ is the return of the benchmark at time t ; I is the information ratio; $r_{p,t}$ is the portfolio return r_b is the return of the benchmark; $\sigma_{r_p - r_b}$ is the standard deviation of the portfolio's excess return.

Although the beta coefficient is not suitable to measure the systematic risk of hedge funds, it can be used to analyse the sensitivity of their performance to current market conditions. Such an analysis can be improved by adding the positive and negative betas proposed by Bacon (Bacon, 2008, pp. 72-73), which measure the sensitivity only to positive or negative benchmark returns.

From the point of view of the investment goals of hedge funds, the evaluation of their portfolio efficiency, which includes their negative investment results, would give a methodologically correct picture of their investment performance. Some of the measures that meet this requirement are those using downside risk. Most popular among them are the Sortino ratio (Sortino & Price, 1994) and the Kappa ratio proposed by Kaplan и Knowels (Kaplan & Knowels, 2004):

$$\text{SortinoR} = \frac{r_p - \text{MAR}}{\sigma_{s\text{MAR}}}, \quad (3)$$

$$\text{Kappa} = \frac{r_p - \tau}{\sqrt{\alpha} \text{LPM}_{\alpha,t}}, \quad (4)$$

where: SortinoR is the Sortino and Price ratio; MAR is minimum acceptable return; $\sigma_{s\text{MAR}}$ is below MAR semi-standard deviation; Kappa is the ratio proposed by Kaplan and Knowels; $\text{LPM}_{\alpha,t}$ is the lower partial moment of order α and target return τ .

In 1999 Sortino, Meer and Plantinga (Sortino, et al., 1999) proposed the upside potential ratio. It shows the average positive return above the target return per unit of downside risk measured as a below target semi-standard deviation:

$$\text{UPR} = \frac{\sum_{t=1}^G \text{Max}[0, (\tau - r_t)]}{\sigma_{s\tau}}, \quad (5)$$

where: UPR is the upside potential ratio; τ is target return; $\sigma_{s\tau}$ is below τ semi-standard deviation.

A measure similar to the upside potential ratio is variability skewness, which was proposed by Bacon (Bacon, 2008, p. 98). It measures the magnitude of the deviation above the target return compared to the deviation below it over a certain period:

$$VS = \frac{\sqrt{\frac{\sum_{t=1}^T [\text{Max}(0, \tau - r_t)]^2}{T-1}}}{\sigma_{sr}}, \quad (6)$$

where VS is variability skewness.

Another hedge fund performance measure was proposed by Bernardo and Ledoit in 1996 (Bernardo & Ledoit, 2000). Their gain to loss ratio is the ratio of the average gain to the average loss over a certain period. In 2002, Keating and Shadwick (Keating & Shadwick, 2002, p. 2) generalised the concept of Bernardo and Ledoit into their Omega ratio:

$$GLR = \frac{[\sum_{i=1}^G \text{Max}(r_i, 0)]/G}{[\sum_{i=1}^L \text{Min}(r_i, 0)]/L}, \quad (7)$$

$$\Omega = \frac{[\sum_{t=1}^T \text{Max}[0, (\tau - r_t)]]/T}{[\sum_{t=1}^T \text{Min}[0, (\tau - r_t)]]/T}, \quad (8)$$

where: GLR is the gain-to-loss ratio; Ω is the omega ratio; $\sum_{t=1}^T \text{Max}[0, (\tau - r_t)]/T$ is average gain above τ ; $\sum_{t=1}^T \text{Min}[0, (\tau - r_t)]/T$ is average loss below τ ; G is the number of gains; L is the number of losses.

The risk of collective investment schemes can also be determined using tools based on the drawdown concept. They are not based on sound scientific foundations, and their best-known forms are the average drawdown, the drawdown deviation, the maximum drawdown and the largest individual drawdown. Due to their simplicity, these tools are very popular and are at the core of a number of approaches for portfolio performance evaluation. One of them is the CALMAR ratio. It was developed by Young (Young, 1991) in 1991 on the base of Sharpe ratio, in which the standard deviation is replaced by the maximum drawdown:

$$CALMAR = \frac{r_p - r_f}{MDD}, \quad (9)$$

where: CALMAR is the ratio proposed by Young; MDD is the maximum drawdown.

In 2006, Zephyr Associates modified Young's methodology by substituting the denominator in equation 9 with the average absolute drawdown. They called this risk metric "pain index" and the related ratio – pain ratio (Odo, 2006):

$$P.R. = \frac{r_p - r_f}{P.I.}, \quad (10)$$

$$PI = \frac{\sum_{i=1}^d |D_i|}{d}, \quad (11)$$

where: P.R. is pain ratio; P.I. is pain index; D_i is the i^{th} drawdown; d is total number of drawdowns.

Ulcer Performance Index is a ratio that uses a risk metric developed in 1989 by Martin and McCann and known as ulcer index (Martin, 2012). The advantage of the ulcer index compared to the pain ratio is that it is very sensitive even to minute losses because it uses their quadratic values:

$$\text{UPI} = \frac{r_p - r_f}{\text{U.I.}}, \quad (12)$$

$$\text{UI} = \sqrt{\frac{\sum_{i=1}^d D_i^2}{d}}, \quad (13)$$

where: U.I. is ulcer index; UPI is ulcer performance index.

The last group of metrics that can be used successfully to evaluate the performance of hedge funds comprises ratios that are highly simplified, but can provide important information that many of the measures discussed above cannot. Morningstar (MorningStar, 2021) defines two of these tools as upside capture indicator and downside capture indicator. The upside capture is a ratio, which divides the average portfolio return during periods when the benchmark had a positive return and the average benchmark return during that same period. The downside capture is a ratio, which divides the average portfolio return during periods when the benchmark had a negative return and the average benchmark return during that same period. The up number ratio and down number ratio proposed by Bacon (Bacon, 2012, p. 34) compare the number of periods for which a portfolio has a positive or negative return to the number of periods in which the benchmark had the same positive or negative return. The up percentage ratio and the down percentage ratio (Bacon, 2008, p. 48) assess how many times the portfolio outperformed the benchmark when the benchmark was up or down, respectively. On the other hand, for a given period of time, the percentage gain ratio proposed by Lhabitant (Lhabitant, 2004, p. 58) and its counterpart per cent loss ratio measure whether a portfolio outperformed the benchmark in numbers of gains or losses.

The performance of the hedge fund industry during the COVID-19 crisis was evaluated using a database of U.S. dollar-denominated net asset value indices of the main hedge fund strategies published by Credit Suisse (Credit Suisse, 2021). The sub-indices of the Event-Driven strategy available in the database (Event-Driven Distressed, Event-Driven Multi-Strategy and Event-Driven Risk Arbitrage) were also analysed. They measure the performance of hedge funds that invest in companies in financial distress, hedge funds applying multiple event-driven strategies and those investing in companies involved in mergers and acquisitions.

The analysis covers the period between the end of October 2018 and the end of February 2021 divided into two equal sub-periods designated as pre-crisis and crisis periods, respectively. The first sub-period is from 31 January 2018 to 31 December 2019, and the second is from 31 December 2019 to 26 February 2021. The main purpose of this subdivision is to compare the performance of the hedge fund industry prior to and during the COVID-19 crisis in order to highlight its effects. Of course, when the analysis was completed, the healthcare aspects of the COVID-19 crisis were still in force. However, the recovery of industrial production and expectations for economic growth in 2021 show that the world economy has overcome or is about to overcome its negative effects. On the other

hand, the growth of the hedge fund industry and financial markets since the beginning of 2021 shows that, as far as the capital markets are concerned, the problems have also been overcome. Moreover, at the beginning of 2021, inflation expectations are already the main drive of the processes on the capital markets, and especially those in the United States. This shows that the financial markets are already entering a fundamentally new phase of their existence, which is not directly related to COVID-19. Therefore, the frame of the crisis period in the study is appropriate and correspond to its goal.

Due to the specific characteristics of the activity of hedge funds and their quasi-opened nature, the analysed data has a monthly frequency. For this reason, the database for the assumed benchmark MSCI ACWI All Cap Index, published by the financial company MSCI (MSCI, 2021), is again with monthly frequency. The index includes data for over 14,000 financial instruments issued on developed as well as emerging financial markets.

The risk-free yield used in the study is the yield of the 3-month U.S. Treasury Bills set by the U.S. Treasury Department (U. S. Department of Treasury, 2021). In order to facilitate the analysis, the same yield is assumed as a target return. For the purposes of the research, the annual risk-free rate is adjusted on a monthly basis and for both sub-periods.

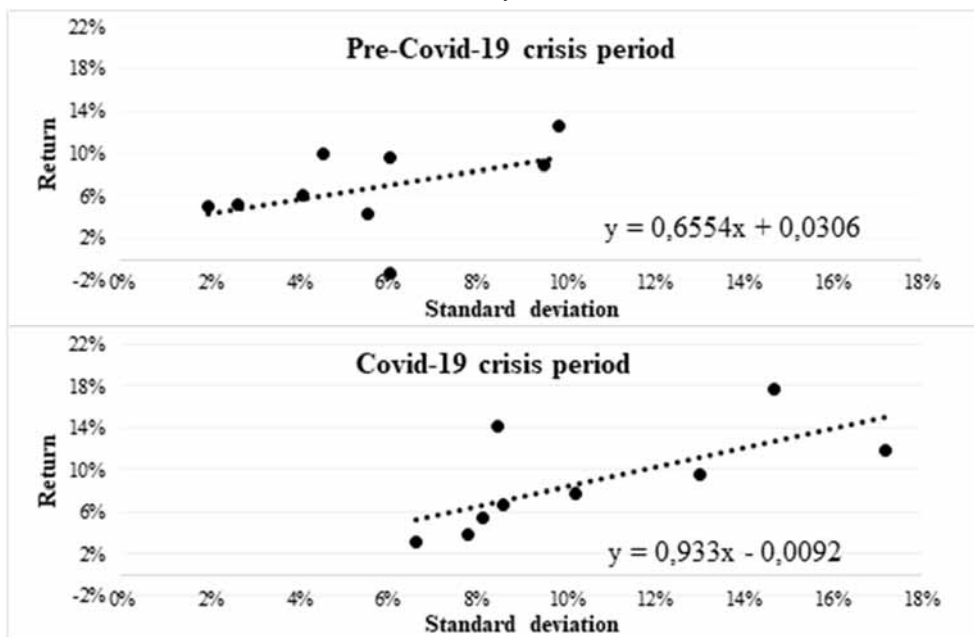
The returns of the benchmark index and the Credit Suisse indices are calculated using a simple growth rate, which is averaged by using a geometric mean. Equivalent to the study period is the value of its standard deviation and below target semi-standard deviation, calculated according to Markowitz (Markowitz, 1991, pp. 188-202). The LPM used in the calculations in the study is of the first order.

4. Empirical Results

The analysis of the dynamics in the hedge fund industry from Figure 1 shows that it was growing throughout the studied period but with wide negative and positive fluctuations of the assets under management. This is confirmed by the results shown in Figure 2, which presents the overall risk-return characteristics of the main hedge fund strategies before and during the crisis. It shows that in the pre-crisis period, the major hedge funds achieved lower overall returns compared to their performance during the crisis. From 31 October 2018 till 31 December 2019, the return of the different hedge fund strategies fluctuated between -1.29% for the Equity Market Neutral strategy and 12.57% for the Emerging Markets strategy. The same two strategies set the lower and upper hedge fund performance margins for the period 31 December 2019 – 26 February 2021 during which the minimum return was 3.08% for the former strategy and 17.78% for the latter.

The better overall return during the COVID-19 crisis period was achieved at the cost of higher risk exposure. Even at a quick glance, the information in Figure 2 shows that during the COVID-19 crisis, the industry took a significantly higher risk than the risk levels before its occurrence. However, the relationship between the standard deviation and the return for the two sub-periods shows that during the crisis period, the hedge fund industry managed to achieve an average return of 0.93% for each unit of investment risk, while in the pre-crisis period, the industry achieved only 0.66% per unit of risk.

Figure 2
Risk-return characteristics of the main hedge fund strategies from 31 October 2018 to 26 February 2021



Source: Author's own calculations.

Table 1 provides a more detailed picture of the overall performance of the main hedge fund strategies. The Sharpe ratio during the COVID-19 crisis was highest for the Convertible Arbitrage and the Emerging Markets strategies. Moreover, both strategies have Sharpe ratios that are greater than the benchmark's Sharpe ratio of 0.7282. The values of the Sharpe ratio of all other hedge fund strategies are lower than this of the benchmark. The worst performance here have Equity Market Neutral and Managed Futures strategies. Against this background, only the Event-Driven Risk Arbitrage sub-strategy has a Sharpe ratio above 2, which is more than three times higher than the Sharpe ratio of the Event-Driven strategy as a whole. All this shows that the seemingly better overall performance of the hedge fund industry during the crisis period is mainly due to the Convertible Arbitrage and the Emerging Markets and, to a certain extent, to the Event-Driven Risk Arbitrage strategy. The situation prior to the crisis was quite different. The strategies like Emerging Markets, Fixed Income Arbitrage, Global Macro, Long/Short Equity and Multi-Strategy had Sharpe ratios greater than 1. Here the Sharpe ratios of Fixed Income Arbitrage, Global Macro and Long/Short Equity strategies were greater than the Sharpe ratio of the benchmark that is 1.0707. It is also worth noting that in the pre-crisis period, the Event-Driven Risk Arbitrage sub-strategy also performed significantly better than the overall Event-Driven strategy and the benchmark index.

Table 1
Sharpe ratio, Information ratio and Tracking error of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period			Covid-19 crisis period		
	Sharpe ratio	Tracking error	Information ratio	Sharpe ratio	Tracking error	Information ratio
Convertible Arbitrage	0.8860	-0.0089	-1.0451	1.6146	-0.0054	-0.2597
Emerging Markets	1.0215	-0.0044	-0.5986	1.1791	-0.0026	-0.0940
Equity Market Neutral	-0.6336	-0.0140	-1.1682	0.3974	-0.0128	-0.7239
Event-Driven	0.3329	-0.0100	-1.3773	0.6638	-0.0060	-0.6148
Event-Driven Distressed	-0.7594	-0.0138	-1.6950	0.5453	-0.0091	-0.7433
Event-Driven Multi-Strategy	0.6296	-0.0084	-1.2253	0.5831	-0.0055	-0.6800
Event-Driven Risk Arbitrage	1.6301	-0.0093	-0.9592	2.0570	0.0000	0.1835
Fixed Income Arbitrage	1.2564	-0.0097	-0.9971	0.6090	-0.0111	-0.6178
Global Macro	1.6471	-0.0063	-0.6514	0.7233	-0.0093	-0.6505
Long/Short Equity	1.1683	-0.0065	-0.9561	0.7023	-0.0079	-0.6385
Managed Futures	0.6581	-0.0068	-0.5201	0.4269	-0.0123	-0.6087
Multi-Strategy	1.0277	-0.0095	-0.9596	0.7163	-0.0103	-0.6412

Source: Author's own calculations.

The data show that only the Event-Driven Risk Arbitrage sub-strategy had a tracking error of 0 during the crisis, while the benchmark outperformed all other strategies in both analysed sub-periods. Therefore, it is no coincidence that all strategies but the Event-Driven Risk Arbitrage have negative information ratios for both sub-periods of the study.

Table 2
Beta, Positive beta, and Negative beta of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period			Covid-19 crisis period		
	Beta	Positive beta	Negative beta	Beta	Positive beta	Negative beta
Convertible Arbitrage	0.2181**	0.3087*	0.24690	0.2540**	0.0488	0.4505*
Emerging Markets	0.4764**	0.45620	-0.7769*	0.4657**	0.0973	0.7590*
Equity Market Neutral	-0.0621	0.30820	-0.46580	0.1578*	-0.1519	0.1718*
Event-Driven	0.3298**	0.3398**	0.31260	0.6109**	0.3537**	0.9705**
Event-Driven Distressed	0.2514**	0.2848*	0.05340	0.4560**	0.3706	0.6917**
Event-Driven Multi-Strategy	0.3781**	0.3782**	0.43890	0.7022**	0.3611**	1.1197**
Event-Driven Risk Arbitrage	0.0953**	0.1391*	-0.05330	0.3380**	0.2443	0.5846*
Fixed Income Arbitrage	0.0917**	0.1285*	-0.02160	0.1715*	-0.2081	0.4952*
Global Macro	0.1495	0.26630	0.07590	0.3464**	0.1405	0.4146**
Long/Short Equity	0.3789**	0.3857**	0.44310	0.4546**	0.1229	0.4122*
Managed Futures	-0.1024	-0.24380	0.86280	0.0597	-0.1637	-0.0224
Multi-Strategy	0.0825	0.14410	0.25770	0.2634**	-0.0511	0.4196**

* statistical significance at 95% confidence interval

** statistical significance at 99% confidence interval

Source: Author's own calculations.

By definition, the sensitivity of hedge fund returns to benchmark returns should be zero. The empirical results in Table 2 show that, with the exception of the Managed Futures strategy in the crisis period, the beta coefficients of all strategies are higher than and statistically significantly different from zero. In the pre-crisis period, the situation for the Equity Market

Neutral, Fixed Income Arbitrage, Managed Futures, Multi-Strategy and Event-Driven Risk Arbitrage sub-strategy was similar, although slightly better. The absence of positive beta ratios greater than 1 in both sub-periods shows that the hedge fund industry, in general, did not have a tendency to make higher than the benchmark return when the global capital markets grow. Moreover, the positive beta coefficients of the Managed Futures strategy in the pre-crisis period and of the Equity Market Neutral, Fixed Income Arbitrage, Managed Futures, Multi-Strategy strategies during the crisis have negative values, which means that in the conditions of growing capital markets, they tended to make negative returns.

The values of the negative beta show that during the crisis, only the Managed Futures strategy had a weak and, in fact, insignificant tendency to achieve positive returns in a declining global capital market. The values of the negative beta of the other hedge fund strategies in this period are positive and statistically significant, which means that during the crisis period, they tended to have a negative performance in a declining capital market. In contrast to the crisis period, in the pre-crisis period, the negative betas of all but three of the strategies and one of the sub-strategies have positive values. However, these values are lower than those in the crisis period, which means that in the pre-crisis period, the hedge funds were less sensitive to the negative side of the systematic risk factor. In contrast to the pre-crisis period, the value of the negative betas of the Emerging Markets, Equity Market Neutral, and Fixed Income Arbitrage strategies and the Event-Driven Risk Arbitrage sub-strategy are negative (and even statistically significant for the Emerging Markets strategy). This means that these hedge fund strategies managed to generate positive returns in the face of a global market downturn.

The data in Table 3 show that during the crisis, the strategies Emerging Markets, Global Macro, Long/Short Equity, Managed Futures and Multi-Strategy have the highest Sortino ratios and with a few exceptions, the highest Kappa ratios. The Fixed Income Arbitrage has the worst performance according to both ratios, which is due to the low return of this strategy throughout the whole period and its relatively high downside risk. It is also worth noting that due to its high return in the period from 31 October 2018 to 31 December 2019, the Event-Driven Risk Arbitrage sub-strategy had the best relative performance considering its asymmetric risk.

Table 3

Sortino&Price ratio and Kappa ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period		Covid-19 crisis period	
	Sortino	Kappa	Sortino	Kappa
Convertible Arbitrage	1.1768	1.7064	0.5637	0.1506
Emerging Markets	0.9874	1.2842	0.8782	0.3584
Equity Market Neutral	-0.4942	-0.6920	0.5496	0.2062
Event-Driven	0.3281	0.4432	0.4413	0.1920
Event-Driven Distressed	-0.6778	-0.7988	0.4273	0.2051
Event-Driven Multi-Strategy	0.5920	0.8089	0.4273	0.2041
Event-Driven Risk Arbitrage	2.1008	2.3828	1.3046	0.4446
Fixed Income Arbitrage	1.1992	1.4889	0.2738	0.0832
Global Macro	2.7064	3.0071	0.7032	0.2725
Long/Short Equity	1.1124	1.4916	0.6779	0.2356
Managed Futures	0.6354	0.7257	0.6545	0.1944
Multi-Strategy	0.8896	1.1316	0.5869	0.2463

Source: Author's own calculations

Despite the lower returns of the main hedge fund strategies in the pre-crisis period, the values of their Sortino and Kappa ratios are significantly higher in general. This is due to their lower downside risk, as the Fixed Income Arbitrage strategy ranks among the leaders in terms of its return per unit of asymmetric risk. The same holds for the Convertible Arbitrage strategy. The Event-Driven Risk Arbitrage sub-strategy also has a very good performance in this respect. In contrast, the strategies with poorer performance during the crisis, such as the Equity Market Neutral and the Event-Driven (together with its Event-Driven Multi-Strategy and Event-Driven Distressed sub-strategies) had low return-to-downside risk ratios in the pre-crisis period as well. Only the Multi-Strategy strategy retained its ranking in both sub-periods.

Table 4

Upside potential, Variability skewness, Gain to loss ratio and Omega ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period				Covid-19 crisis period			
	Upside Potential	Variability Skewness	Gain to Loss	Omega	Upside Potential	Variability Skewness	Gain to Loss	Omega
Convertible Arbitrage	0.0410	1.6361	1.7830	1.7917	0.0173	0.2772	0.2398	0.2326
Emerging Markets	0.0649	0.9969	0.9244	1.0583	0.0636	0.6717	0.9147	0.8937
Equity Market Neutral	0.0099	0.5054	0.6575	0.6096	0.0618	1.9027	2.5469	2.3991
Event-Driven	0.0269	0.9763	1.7025	1.1957	0.0445	0.4912	0.7048	0.6895
Event-Driven Distressed	0.0136	0.7845	1.1855	0.7941	0.0467	0.6505	0.9289	0.9002
Event-Driven Multi-Strategy	0.0329	0.9130	1.0913	1.0938	0.0528	0.5527	0.9297	0.9115
Event-Driven Risk Arbitrage	0.0219	1.5386	2.2401	1.3791	0.0620	0.6519	0.6663	0.6486
Fixed Income Arbitrage	0.0126	0.9822	1.1852	1.0522	0.0117	0.2752	0.2778	0.2664
Global Macro	0.0763	2.0755	2.0972	1.6843	0.0582	0.9845	0.9504	1.2385
Long/Short Equity	0.0395	0.9847	1.0881	1.1221	0.0727	0.9710	1.2095	1.1793
Managed Futures	0.0593	0.9674	1.0276	0.8438	0.0920	2.0568	1.8986	1.8085
Multi-Strategy	0.0131	0.8183	1.3245	0.9428	0.0357	0.7269	0.9873	0.9452

Source: Author's own calculations.

The data in Table 4 show that the Managed Futures, the Long/Short Equity, and the Emerging Markets strategies had the highest growth potential during the COVID-19 crisis. For each additional unit of downside risk, they had an excess return above the benchmark of 0.092%, 0.073%, and 0.064%, respectively. The Event-Driven, the Multi-Strategy, the Convertible Arbitrage and the Fixed Income Arbitrage had the worst upside potential ratios during the crisis, the main reason for this being their large below target semi-standard deviation, which in some cases is between four and five times higher compared to the strategies with the highest upside potential. This is the reason why the Managed Futures and the Equity Market Neutral have a very strong variation of their positive return above the target return compared to this below it. During the COVID-19 crisis, the deviation below the target return of all other strategies is deeper and/or longer than that above it. The gain-to-loss ratios show that the average positive return of the Equity Market Neutral, the Managed Futures and the Long/Short Equity strategies throughout the period was higher than their average negative return, something that is not valid for the other analysed strategies. A comparison of the data in Table 4 shows that prior to the COVID-19 crisis, most of the strategies had lower upside potential than during the crisis. However, a great number of them had bigger positive deviations from the target return than negative deviations from it. Their average gain-to-loss

ratio was also better, as in ten of the strategies, it was greater than one. This means that, prior to the crisis, the hedge funds that applied these strategies on average gained more than they lost. This particularly holds for the Global Macro strategy and the Event-Driven Risk sub-strategy and does not apply only to the Emerging Markets and the Equity Market Neutral strategies.

Table 5

CALMAR, Pain ratio and Ulcer Performance Index of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period			Covid-19 crisis period		
	CALMAR	Pain ratio	UPI	CALMAR	Pain ratio	UPI
Convertible Arbitrage	1.9379	14.3231	0.4557	2.1215	13.7081	0.4146
Emerging Markets	1.7502	7.6832	0.2923	1.6090	9.5410	0.3153
Equity Market Neutral	-0.8904	-2.2704	-0.1263	0.4989	1.6097	0.0774
Event-Driven	0.5224	2.3040	0.0987	0.7161	2.6583	0.1168
Event-Driven Distressed	-0.8565	-1.9529	-0.0991	0.6481	1.8852	0.0902
Event-Driven Multi-Strategy	0.9508	5.3454	0.2044	0.6119	2.2953	0.1003
Event-Driven Risk Arbitrage	7.8119	55.4173	1.4544	3.1659	24.2536	0.6928
Fixed Income Arbitrage	2.3015	17.9354	0.4947	0.5967	2.5608	0.0966
Global Macro	8.6018	34.9096	1.2973	0.9126	4.0420	0.1636
Long/Short Equity	2.8625	16.2171	0.5128	0.8194	3.7401	0.1559
Managed Futures	0.9048	3.1817	0.1279	0.6472	1.5863	0.0804
Multi-Strategy	1.4397	8.7949	0.2789	0.8280	3.6356	0.1418

Source: Author's own calculations.

Table 5 presents the performance of the different hedge fund strategies according to their drawdown risk. Obviously, during the COVID-19 crisis, the Convertible Arbitrage, the Emerging Markets, and the Global Macro strategies had an outstanding performance in terms of their CALMAR, Pain ratio, and Ulcer Performance Index. However, they and all other strategies in the analysis were outperformed by the Event-Driven Risk Arbitrage sub-strategy. What is more, the other event-driven strategies included in the analysis, as well as the Managed Futures, the Fixed Income Arbitrage and the Equity Market Neutral strategies had the worst performance in this sub-period according to the same criteria. Here the strategies with poor performance tend to maintain their low rank across the three assessment criteria. This means that the magnitude of their drawdowns is relatively the same, regardless of the computational approaches used. The only more significant discrepancy in the assessments of the Fixed Income Arbitrage and the Managed Futures strategies shows that during the crisis, they had a higher maximum but relatively lower average and squared drawdown and a lower maximum but higher average and a squared drawdown, respectively.

The data in Table 5 show that during the pre-crisis period, all strategies had better indicators compared to the crisis period, which, considering their lower return in the period 31 October 2018 – 31 December 2019, means that they had achieved lower drawdowns. The second important conclusion is that the strategies with poor performance in the crisis period had poor performance in the pre-crisis period as well. The only significant exception is the Fixed Income Arbitrage strategy, which means that prior to the crisis, most debt markets were growing. Another observation for the pre-crisis period is the poor performance of the

Convertible Arbitrage strategy, which means that there weren't appropriate arbitrage opportunities between the debt and the equity markets.

Table 6

Upside capture, Downside capture, Up number ratio and Down number ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period				Covid-19 crisis period			
	Upside capture	Downside capture	Up number	Down number	Upside capture	Downside capture	Up number	Down number
Convertible Arbitrage	0.2466	0.1514	0.8182	1	0.3291	0.1023	1	0.1667
Emerging Markets	0.6144	0.5490	0.9091	1	0.5359	0.3235	1	0.6667
Equity Market Neutral	-0.1134	-0.1758	0.5455	0.3333	0.2033	0.2391	0.6250	1
Event-Driven	0.2911	0.3496	0.6364	1	0.5572	0.5223	1	0.6667
Event-Driven Distressed	0.1273	0.3305	0.5455	1	0.3946	0.3911	0.8750	0.6667
Event-Driven Multi-Strategy	0.3678	0.3772	0.8182	1	0.6317	0.6304	1	0.8333
Event-Driven Risk Arbitrage	0.1780	0.0408	0.9091	0.6667	0.4471	0.0486	1	0.3333
Fixed Income Arbitrage	0.1628	0.0437	0.9091	0.6667	0.1706	0.1024	0.8750	0.1667
Global Macro	0.2892	0.0151	0.7273	0.3333	0.3706	0.3618	0.8750	0.6667
Long/Short Equity	0.4296	0.3381	0.9091	1	0.5243	0.5597	1	1
Managed Futures	0.1319	-0.2793	0.6364	0.3333	0.1485	0.1189	0.5000	0.6667
Multi-Strategy	0.1471	-0.0075	0.8182	0.6667	0.2872	0.2626	1	0.8333

Source: Author's own calculations.

The information in Table 6 shows that during the COVID-19 crisis, most hedge fund strategies have managed to achieve positive returns in periods when the benchmark grows. Only the Fixed Income Arbitrage, the Global Macro, the Equity Market Neutral, the Managed Futures strategies and the Event-Driven Distressed sub-strategy fail to do so in all periods where MSCI ACWI All Cap Index is up. On the other hand, the values of the down number ratio show that, with the exception of the Equity Market Neutral and the Long/Short Equity strategies, most parts of the hedge fund industry has managed to hedge itself against market downturns. However, both findings should not lead to over-optimism, because throughout the specified period, no hedge fund strategy managed to achieve a higher return than the benchmark when it was up. Moreover, no hedge fund strategy achieved a return that exceeds 63.17% of the positive return of the MSCI ACWI All Cap Index and only the Event-Driven, the Emerging Markets, the Long/Short Equity and the Event-Driven Multi-Strategy achieved returns exceeding 52.43% of its return. The same strategies in the conditions of a declining capital market and especially the Event-Driven, the Long/Short Equity, and the Event-Driven Multi-Strategy had the highest average negative returns. Here the strategy Event-Driven Risk Arbitrage is again the best performer. The situation is even worse considering the pre-crisis data. During this period, the industry failed to keep pace with the benchmark when it was growing. Almost half of the strategies had negative returns during market decline and as a whole, the values of the up capture indicator are worse than those during the crisis period. Only the Emerging Markets strategy had an average performance close to its performance during the COVID-19 crisis sub-period. On the other hand, only the strategies like Managed Futures, Equity Market Neutral and Multi-Strategy managed to achieve a positive average return in conditions of market decline.

The final aspects of the performance of the analysed hedge fund strategies are shown in Table 7. The values of the up per cent ratio indicate that during the crisis, about half of the analysed strategies did not outperform the MSCI ACWI All Cap Index during market growth. The index was defeated only twice by the Managed Futures strategy and only once by the other strategies with similar performance. In conditions of market decline, the hedge funds had better results than MSCI ACWI All Cap Index. Eight of the hedge fund strategies had better returns than the index return, and four of them failed to make this only once. During the crisis, nine strategies had a greater number of positive returns than the benchmark, one strategy (the Long/Short Equity) had equal positive returns like the benchmark, and only the Equity Market Neutral and the Managed Futures strategies scored fewer positive returns than the benchmark. The values of the percent loss ratio confirm again the conclusion that the hedge fund industry performs well during a market decline, with the Equity Market Neutral and the Managed Futures again score more losses than the MSCI ACWI All Cap Index.

Table 7
Up per cent ratio, Down per cent ratio, Percent gain ratio and Percent loss ratio of the main hedge fund strategies before and during the COVID-19 crisis

Strategy	Pre-Covid-19 crisis period				Covid-19 crisis period			
	Up %	Down %	Per cent gain	Per cent loss	Up %	Down %	Per cent gain	Per cent loss
Convertible Arbitrage	0	1	0.8182	1.6667	0	1	1.6250	0.1667
Emerging Markets	0.3636	0.6667	0.9091	1.3333	0.1250	1	1.2500	0.6667
Equity Market Neutral	0	1	0.7273	2	0	1	0.6250	1.5000
Event-Driven	0	1	0.6364	2.3333	0.1250	1	1.2500	0.6667
Event-Driven Distressed	0	1	0.5455	2.6667	0.1250	1	1.1250	0.8333
Event-Driven Multi-Strategy	0.1818	1	0.8182	1.6667	0.1250	0.8333	1.1250	0.8333
Event-Driven Risk Arbitrage	0	1	1	1	0.1250	1	1.5000	0.3333
Fixed Income Arbitrage	0	1	1	1	0	1	1.5000	0.3333
Global Macro	0.1818	1	0.9091	1.3333	0	1	1.1250	0.8333
Long/Short Equity	0.0909	1	0.9091	1.3333	0.1250	0.8333	1	1
Managed Futures	0.1818	1	0.8182	1.6667	0.2500	0.8333	0.7500	1.3333
Multi-Strategy	0.0909	1	0.9091	1.3333	0	0.8333	1.1250	0.8333

Source: Author's own calculations

During the pre-crisis period, the situation was different because all strategies underperformed in more cases compared to the benchmark index. During this period, only the Fixed Income Arbitrage and the Event-Driven Risk Arbitrage strategies had more positive returns than the MSCI ACWI All Cap Index. However, in the pre-crisis period, the industry as a whole had better performance in terms of risk hedging and protection of investors' wealth. Only the Emerging Markets strategy failed to beat the benchmark in conditions of market decline. Moreover, before the beginning of 2020, most hedge fund strategies had never been able to outperform the benchmark in conditions of market growth. The only significant exception is the Emerging Markets strategy, which outperformed the market four times, and some of the other strategies had better performance only once for the entire period.

Conclusion

The study presents an analysis of the impact of the COVID-19 crisis on the performance of different hedge fund strategies by the end of 2019 and in the first months of 2021. The analysis covers nine strategies and three sub-strategies and its main empirical results lead to the following conclusions:

First. The empirical results imply that during the COVID-19 crisis, all components of the hedge funds industry partially achieved their main investment goal. In general, the various strategies applied in the hedge fund industry provide good hedging of the investment risk in a declining market. However, they do not outperform the benchmark in an upside market. An interesting fact is that this conclusion is valid for the pre-crisis period as well.

Second. During the crisis, the different hedge fund strategies have higher Sharpe ratios than during the pre-crisis period. However, before the COVID-19 crisis, most of the hedge funds had Sharpe ratios that approximated or exceeded the Sharpe ratio of the benchmark. Moreover, most of the analysed hedge fund strategies had lower returns than the market in both sub-periods, which indirectly supports the opinion that they did not achieve their main investment goal in full.

Third. The analysed hedge fund strategies and sub-strategies have almost twice as high average return in the period 31 December 2019 – 26 February 2021 compared to the pre-crisis period. However, this was achieved at the cost of taking almost double the investment risk measured in terms of standard deviation.

Fourth. The downside risk taken by the hedge fund industry during the crisis period is significantly higher compared to the pre-crisis period. With a below and above target semi-standard deviation, the asymmetrical risk is respectively almost two and three times higher. On the other hand, the average LPM for the industry during the COVID-19 crisis is more than ten times higher than prior to the crisis. A detailed analysis of the negative shocks of the return in the hedge fund industry during the crisis shows that they are relatively few but with significant size and impact. In contrast, in the pre-crisis period, their number is greater, but they have lower size and impact.

Fifth. The most effective strategy during the COVID-19 crisis is undoubtedly the Event-Driven Risk Arbitrage. Its performance is significantly better than that of all other analysed strategies. Moreover, it is much better than the overall performance of all Event-Driven strategies combined, as well as the Event-Driven Multi-Strategy and the Event-Driven Distressed strategy. This performance is largely due to the very good condition and rapid recovery of the global M&A market, especially in the second half of 2020, as well as the growing popularity in the United States of investment strategies based on SPAC structures. This allowed the hedge funds to benefit from the strengths of the Risk Arbitrage strategy, in which the only source of risk are legal M&A procedures that are not directly related to capital market processes. Provided that the volume of the mergers and acquisitions market in the corporate world remains unchanged, we may expect that hedge funds that follow the Event-Driven Risk Arbitrage strategy will continue to have a very good performance in the near future.

Sixth. Other hedge fund strategies with very good performance during the COVID-19 crisis period are the Emerging Markets, the Global Macro and the Long/Short Equity. Obviously, these are the strategies in which the hedge funds have managed to diversify globally the sources of return and risk or have made an effective portfolio selection. The slower expected recovery of the emerging markets in 2021 compared to the developed economies may lead to poorer performance of the hedge funds that apply the Emerging Markets strategy and better performance of those applying the Global Macro and the Long/Short Equity strategies.

Seventh. Strategies such as Convertible Arbitrage, Multi-Strategy and Managed Futures had a mediocre performance during the crisis, as the market conditions between 31 December 2019 and 26 February 2021 did not allow effective implementation of investment approaches intended to mitigate the systematic risk. Therefore, the performance of the Equity Market Neutral strategy can be described as unsatisfactory. The same assessment can be given for all Event-Driven strategies except for the strategy based on the arbitrage of companies engaged in mergers and acquisitions.

Eighth. Despite its relatively high ranking according to some of the criteria, the investment strategy with the poorest performance during the COVID-19 crisis is the Fixed Income Arbitrage. This is largely due to the loose monetary policy of central banks in countries with developed capital markets, which is why their bond markets are overvalued and without significant growth potential at the onset of the COVID-19 crisis. Another factor for the poor performance of the Fixed Income Arbitrage is the upward trend in U.S. government bond yields after mid-2020. The rising inflation expectations at the beginning of 2021 indicate that this strategy is likely to perform poorly in the foreseeable future.

Ninth. The performance of the different hedge fund strategies between 31 October 2018 and 31 December 2019 does not differ significantly from their performance during the crisis. The only differences are in terms of the ranking of some of the strategies and the slightly better performance of others. For example, the best overall performance in the pre-crisis period is observed for the Global Macro strategy, followed closely by Event-Driven Risk Arbitrage. Also impressive is the much better performance of the Fixed Income Arbitrage strategy and the slightly better performance of the Convertible Arbitrage strategy.

Tenth. The use of metrics such as upside and downside capture, up number and down number, up percentage and down percentage, per cent gain and percentage loss ratio can lead to conflicting assessments of the effectiveness of the hedge fund strategies against other metrics used in the study. Therefore, in the case of portfolio performance analysis of hedge funds, they should be used in combinations rather than independently.

These findings present some important characteristics of the hedge fund industry during the COVID-19 crisis. Of course, the study is far from comprehensive and covers only the different components of the hedge fund industry. That is why the main directions for further work are related to investigating the individual performance of different hedge funds and the trends in their development.

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TOURISM IN COVID-19 PANDEMIC: CONSEQUENCES AND THE WAY FORWARD³

COVID-19 pandemic emerged as a shock to the world, leading it towards an unprecedented socioeconomic crisis. Amongst all the sectors of the global economy, tourism was hit the hardest. Non-pharmaceutical interventions put in place to curb the spread of the disease, deeply impacted the activities in the global tourism community. Owing to the pandemic, the global community is being pushed into a recession. Tourism is crucial to the economic recovery of the world. Therefore, this study focuses on examining the consequences of the pandemic on the global tourism sector. Since tourism does not work in isolation and is intertwined with its associated sectors, the study considers the impact of the pandemic on aviation, hotel and accommodation and MSMEs in tourism. For this purpose, a regional analysis has been conducted. The findings reveal that the Asia-Pacific region has been consistently performing poorly in terms of tourism-related indicators. Europe stood second in place. However, during the resurgence of the second wave and new variants of the virus, it kept on switching places with the Asia-Pacific region. Tourism is considered to be a resilient sector as it bounces back to the pre-crisis levels eventually. However, the evolving nature of the pandemic has created huge difficulties for the sector to start its recovery. Hence the paper also discusses the future of travel in the next normal.

Keyword: COVID-19; Global tourism; Recession; Regional-analysis Next normal

JEL: M21; Z30; Z32; Z38

1. Introduction

The COVID-19 pandemic emerged as a health crisis and took the entire world by surprise. It led to unprecedented health challenges, which evolved into the biggest socioeconomic crisis witnessed globally. At the time of the outbreak of the novel coronavirus in China during

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December 2019, no one imagined such a catastrophic loss of lives and livelihoods. The rapid evolving nature of the virus and the pace of its spread had far-reaching consequences catching all the government forces by their neck. With no immediate response to curb the spread of the lethal infection, governments across the world imposed non-pharmaceutical interventions, mandating lockdowns and restrictions on the movement of people from one place to another apart from implementing critical social distancing measures (Barbuddhe et al., 2020). This resulted in the closure of daily activities, suspension of schools and colleges, closures of shopping malls and places of recreation and a complete restriction of activities other than the necessary ones in most parts of the world (Ivanov et al., 2020). The suspension of economic activities led to a substantial fall of major sectors of the economies. Hence, within the first few months of the emergence of the pandemic, the health crisis had turned into an economic crisis (Jamal, Budke, 2020).

Tourism became one of the most affected sectors due to this catastrophe as it relies heavily on human interaction and movement across places. The implementation of the restrictions on travel meant that tourism was about to witness a huge plunge. It is considered to be a people's sector and is closely associated with various industries, like aviation, hotels and restaurants, transportation, small tourism-related businesses (such as tour planners, tour operators, travel guides, etc.), among others. As soon as the restrictions came into place, all these associated sectors started witnessing massive cancellations and losses in terms of revenues, making their survival difficult. Small unskilled or low skilled groups were at the brim of losing their source of livelihoods. Within the first few months of 2020, the aviation sector had witnessed such low demand and travel that were last witnessed during the severe acute respiratory syndrome (SARS) outbreak in 2003. Around the world, hotels and associated sectors were vacant, small businesses were mostly closed and several of them had to shut down with continuous months of zero demand. According to the United Nations World Tourism Organization (UNWTO), the tourism sector, for the first time ever, was witnessing a decline of around 60-80 per cent of tourist arrivals and had supposedly 100-120 million jobs at risk.

Episodes of past pandemics and epidemics have shown that tourism is resilient enough to bounce back. However, the magnitude of the fall being witnessed by the sector by May 2020, had raised several serious questions about the future. At the same time, it was also considered that the sector might be the last one to recover as consumer and business confidence had reached unprecedented low levels with no hope of revival. Against this background, the current study aims to analyse the impact and effect of the deadly pandemic on the tourism sector. For this purpose, the study has segregated the world into five regions, namely, Asia-Pacific, Europe, Americas, Middle East and Africa, in order to carry out a comprehensive regional analysis. The study also focuses on the impact on associated sectors of tourism, including aviation, hotel and accommodation and micro, small and medium enterprises (MSMEs) in tourism-related businesses. Analysing the evolution of the global tourism sector in the last few decades, surviving various epidemics and pandemics can help better understand the impact of COVID-19. Therefore, the study has undertaken a review of the literature on the relationship between crises and tourism. Further, the growth of the sector in light of the development in the past few decades has been undertaken to understand the decline of tourism in recent times.

The paper adds to the existing literature in three distinct ways. First, it is one of the early studies to undertake a region-wise analysis of tourism and its allied sectors since the start of the pandemic. It takes into consideration the time duration of the first and the second wave of the virus and also discusses the impact of the new variants of coronavirus on the entire global tourism community. Secondly, the paper provides a background on the relation of tourism with the past and the present on-going pandemic, providing evidence of the susceptibility of the sector to external shocks. Lastly, the paper discusses tourism in the context of the next normal and highlights the ways in which the sector has undergone a transformation during the pandemic. It also illustrates the various aspects which shall help in the recovery of and support in restarting tourism.

2. Literature Review

2.1. Crises and Tourism

The increase in global mobility and the transformation of countries into gig economies have integrated and enhanced the interaction between individuals. Globalisation and urbanisation have facilitated this movement of people and triggered the need for new activities that promote and encourage this interaction (Richter, 2003; Maditinos & Vassiliadis, 2008). Today, the world is more connected than ever, and a major reason behind this is the expansion and growth of the tourism sector. Tourism has helped in connecting the far corners of the world easily and swiftly. In this way, it has promoted increased interaction amongst humans around the world. This closeness, however, has a downside. The interconnectivity flourished by enhanced tourism has exposed mankind to all sorts of risks such as climate change, global warming, increase in the infections of pathogens, viruses and other microorganisms. In this way, tourism has become a starting point and a significant contributor to major pandemics and epidemics (Sigala, 2020).

The impact of pandemics and epidemics have always had far-reaching. They not only affect the social well-being of any economy, but also generate a huge economic deficit for the same (Begley, 2013). The consequence of these crises is much more severe in developing nations where the infrastructure is still evolving. The burden triggered by such crises disturbs the economic building of the nation and drives the development backwards. The increased interaction and connectivity of the world facilitated through and promoted by tourism has increased the vulnerability and susceptibility of economies around the world to crises, both health and socioeconomic (Begley, 2013). Even if an outbreak of a disease takes place in one corner of the world, its impact is felt by the rest of the world (Cohen, 2012). Tourism here becomes a carrier of the disease. The earliest example is the outbreak of the Spanish Flu in 1918, where the movement of the troops across Europe and the US, led to a rapid spread of the disease which killed millions (Crosby, 1990). Similar instances were seen during the outbreak of SARS (Severe Acute Respiratory Syndrome), MERS (Middle East respiratory syndrome), the Avian Flu, H1N1 Virus, influenza and yellow fever, among others (Kilbourne, 2008; Kuo et al., 2020). In most of the health crisis, the first intervention has been social distancing and a halt on the movement of people (Gössling et al., 2020). There is a critical link between the health crises and the impact of the same on the global tourism

sector (Page et al., 2006). However, the intensity of the impact and the extent of the same, has been different depending upon the geographical location of the outbreak of the disease.

During the SARS outbreak in China in 2003, there was a drop of 674 million tourist arrivals. Other nations like Hong Kong and Singapore, which also suffered from the SARS epidemic, lost almost 70 per cent of their tourism activities within the first few months of the outbreak (Wanjala, 2020). The virus eventually spread to 26 countries around the world, leading to massive economic loss by tourism and its associated sectors (Wilder-Smith, 2006). For instance, North American Airlines suffered a loss of almost USD 1 billion in terms of revenue, while Asia-Pacific Airlines lost over USD 6 million. At the same time, the Canadian hotel segment lost around USD 4.3 billion, while the Chinese luxury hotel industry lost almost 80 per cent of their revenues (Keogh-Brown & Smith, 2008; Wanjala 2020). Similarly, in the case of the MERS outbreak, the tourism sector in Saudi Arabia had to suffer a loss of over USD 5 billion. Mexico was also hit by the epidemic and hence its tourism lost over USD 3 billion of its revenues due to the loss of over a million tourists (World Bank, 2017; Wanjala, 2020). Again, the episodes of Ebola outbreak during 2015 witnessed a decline in tourism activities and loss of revenues in West Africa (Novelli et al., 2018). According to Hall (2015), in today's interconnected socioeconomic world, a global pandemic would become the "perfect storm", which leads to a crisis of unforeseen trajectories. The emergence of the current pandemic has indeed taken the world into a crisis that was exceptional, the ramification of which will be realised only with the passage of time.

2.2. The Growth of Global Tourism in Recent Times

Tourism is a major economic-driver globally. It accounts for one-tenth of the global GDP and generates 10 per cent of employment opportunities making it the largest employment-generating sector. It also employs millions of workers in the informal sector, including migrants, semi-skilled or low-skilled workers, women, youth and students (Faus, 2020). Apart from these, the sector is a mainstay for several MSMEs. The tourism supply chain is interconnected with various other sectors such as accommodation, transportation, food and beverages, travel, among others. Thus, it is multi-dimensional in nature. Hence, tourism is a critically important sector for any economy, especially in its developmental phase.

Over the last few decades, the global tourism sector has witnessed substantial growth. One of the reasons for the sector's growth is the increasing income levels around the world. Travel has become much more easy and feasible now with the rise of low-cost airlines, cheap accommodation and rental facilities and cheaper destination transport. As a result, in the last century, tourism has witnessed a growth of 117 per cent. In fact, for the year 2000, tourism witnessed merely 680 million tourist arrivals, but by the year 2017, the sector recorded 1.3 billion international tourist arrivals. In the following year, there was a growth of more than six per cent and in 2019, the international tourist arrivals were recorded at 1.5 billion (UNWTO, 2020a). This was the ninth consecutive year of growth for the sector.

Traditionally, Europe has been the major source of tourists. However, over time a shift in the trend has been observed. In the last few years, there has been a substantial growth in Chinese tourists, making the Asia-Pacific region the second largest source of tourists (Moon, 2018).

As for destinations, Europe has always been the most visited place by tourists. A shifting trend has been observed here also, as Asia-Pacific is catching up with Europe and now attracts a large number of tourists every year. These patterns in the previous years, made experts optimistic and ready to witness the tenth consecutive growth year within the tourism sector. The calendar events of 2020, such as the Tokyo Olympics, the Dubai expo, the Beethoven, the French Open and the others had geared the tourism sector to grow by 3-4 per cent in 2020 (UNWTO, 2020a).

3. Research Methodology

This study is explanatory in nature and seeks to analyse the situation in the global tourism sector in light of the pandemic. In order to get a better understanding of the magnitude of the crisis on tourism, the study also examined its allied sectors, viz. aviation, hotels and accommodation and tourism-related MSMEs. The study is conducted while the pandemic is still evolving and COVID protocols are in place, therefore, secondary data is used for analysis. Various articles, reports, periodicals and databases published by the renowned organisation including, United Nations World Tourism Barometer (UNWTO), Smith Travel Research (STR), World Travel and Tourism Council (WTTC), United Nations Conference on Trade and Development (UNCTAD), Organisation for Economic Co-operation and Development, International Air Transport Association (IATA) and International Monetary Fund (IMF) and other reports by governmental and non-governmental bodies have been used. Due to the evolving nature of the pandemic and the time-lag in the availability of the latest databases, various news articles, blogs and expert opinions have also been taken into consideration.

The time period for the study is between January 2020 and July 2021. The study, in this manner, considers the beginning of the outbreak and continues to cover the entire year for which the sector has been under economic stress and loss. For the purpose of the same, a regional analysis was considered since the availability of data for a country-wise analysis was constrained. At the same time, for the hotel and hospitality sector, the latest region-wise available data was up to November 2020 only. Therefore, the same has been considered for that sector. Furthermore, with the progression of the pandemic and emergence of new variants, the prediction of the future is difficult and can be highly dangerous. Until the pandemic is over and the economies return to their normal functioning, the extent and impact of the pandemic cannot be made with certainty. Even then, the paper has made an attempt to visualise tourism in the next normal.

4. Tourism Sector in COVID-19 Times

The COVID-19 crisis has completely changed the face of tourism. The closure of Wuhan airport in the month of January 2020, and subsequently entire China was the first step towards the fall of tourism worldwide. The repercussions of the same were severe as international tourist arrivals declined by almost 22 per cent between the months of January-March 2020. The panic associated with the virus travelled at a faster rate than the virus itself and eventually

by March, the entire world entered into a lockdown phase. The declaration of the infectious diseases as a pandemic in March, sent shocks across the tourism supply chain. In the first quarter of 2020, the sector lost around USD 80 billion worth of its exports. These losses increased as the months went by and towards the end of 2020, tourism had recorded a loss of USD 935 billion in terms of exports. The overall loss of tourist arrivals had also reached 1 billion worldwide. The loss in terms of tourism receipts, USD 1.1 trillion, was lost by November 2020. All of these led to a massive economic loss which was equal to almost 2 per cent of the global GDP recorded in 2019 (UNWTO, 2020b). Since the world was under unprecedented lockdown for more than half of the year, the sector lost 70 per cent of its output as well. This led to a much higher fall in employment activities within the sector. Around 100-120 million people employed in the tourism industry lost their livelihoods.

The nations worldwide resorted to travel-related restrictions which were imposed on both domestic and international travellers. These restrictions ranged from a complete ban on travel, complete or partial closure of borders, suspension of flights partially or fully, destination-specific restrictions to different forms of small measures. As the months progressed, these restrictions became critical, leaving countries in despair. By region, Europe had installed the maximum number of restrictions and 83 per cent of the European destinations were completely sealed for any form of tourism. Next was America with 80 per cent of closed destinations, Asia-Pacific's 70 per cent destinations, Middle East's 62 per cent and Africa with 57 per cent destinations with closed borders.

The tourism sector is entirely based on human interaction. The activities in the sector are based on the movement of people to different places and the services required to facilitate the smooth movement of people. Therefore, the graph of the impact of the pandemic on the sector fluctuated as and when the number of cases increased or decreased. Hence, the restrictions imposed were at their peak when the virus was spreading widely around the world in the months between January-March 2020 (See Figure 1). By May 2020, the unlock phase began and the governments worldwide started easing the critical travel restrictions and replaced them by measures such as negative PCR test and quarantine, medical certificate and vaccination certificate.

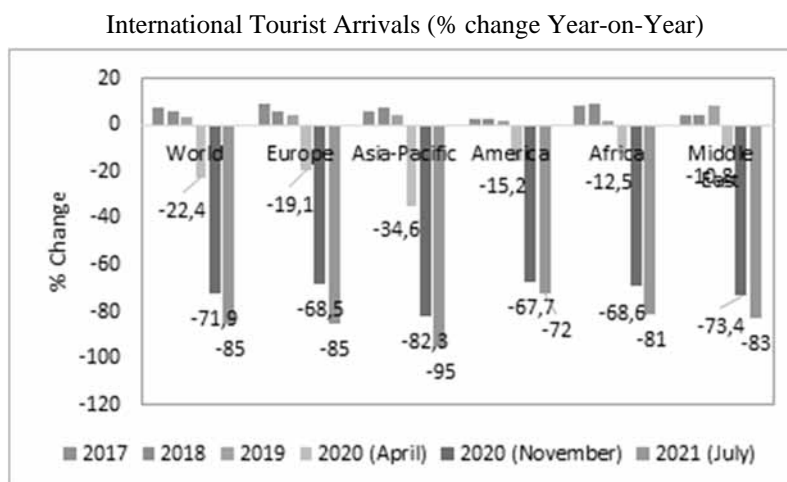
The pandemic is said to have peaked in the months of June, July and August 2020, after which the number of cases started decreasing. Interestingly, the second wave of the coronavirus came in the months of September and October and once again the countries started imposing lockdowns. However, by this time, vaccination drives had already started and therefore, the sector did not have to come to a complete halt. In fact, by November, Europe had lifted almost 91 per cent of its travel-related restrictions. The consumer confidence was, however, rising slowly, especially with the pace of vaccination roll-outs and certain tourism-related policies adopted by nations, such as the EU Green Certificate. The future, still uncertain, had some hopes of recovery. The resurgence of the virus and the new variants, however, led most countries to re-introduce the travel restrictions and in February 2021, around 32 per cent of destinations worldwide had completely closed their borders.

By the time the year 2020 came to an end, the pandemic had already created a ruckus in the tourism sector and left it in despair. The earlier projections of 3-4 per cent growth were reversed and the sector was set to witness a 60-80 per cent fall in tourist arrivals. The actual figures have not been quite different from the projections. In fact, the year 2020 recorded a

73 per cent decline in international tourist arrivals. By the end of March 2020, the sector recorded a decline in tourist arrivals of over 57 per cent. The months of June and July, the supposed busiest months of the year, actually witnessed almost 81 per cent and 79 per cent less tourist arrivals. The figures look depressing, but they were the first signs of a weak recovery of the sector. Consumer confidence started to increase slightly and domestic tourism started recovering in certain parts of China and Russia. This recovery, however, was very short-lived. The second-wave struck again and once again nations entered into phased-lockdowns. Only, this time, the European region suffered the most, followed by the USA and then Asia-Pacific.

It is important to understand that in the last few decades, the influence of China on international tourism has increased a lot. Therefore, the eruption of the virus in China, its subsequent lockdown and then the reopening had all put a lot of pressure on global tourism. So overall, the Asia-Pacific region seems to suffer the brunt of the pandemic. Around the world, between the months of January-October, travelling had declined by almost 72 per cent. Since the virus first originated in an Asian country, the perceived image of Asia, for all the other nations around the world, has been affected. This is one of the major reasons why the Asia Pacific suffered the most in the entire world (See Figure 1). The consumer confidence was the bleakest when travelling to this region. The data reveals that, by November 2020, Asia-Pacific lost around 82 per cent of tourist arrivals, while the Middle East and Africa recorded a loss of around 73 and 69 per cent, respectively (See Figure 1). Since Europe and America had reopened their borders for some time, their loss was comparatively less, with 68 per cent fewer tourist arrivals.

Figure 1



Source: UNWTO Barometer, 2019; UNWTO Barometer, January, 2020; UNWTO Barometer, December, 2020, UNWTO Barometer, July, 2021.

In the first quarter of 2020 itself, the industry recorded a loss of almost 67 million tourists. By October, the sector had witnessed 900 million fewer tourist arrivals than in the same period in 2019 (UNWTO, 2020b). The sector was geared up for the next year 2021 with the

hope of seeing some recovery. However, the emergence of variants of coronavirus, shattered all hopes of a recovery in the sector. During the first three months of 2021, almost 83 per cent of destinations worldwide. The Asia-Pacific region continued to suffer the most as it lost over 94 per cent of international tourist arrivals in these three months as compared to the same time in 2020. Europe was next in line as it witnessed 83 per cent lesser, Africa 81 per cent lesser, Middle East 78 per cent and America 71 per cent lesser tourist arrivals (UNWTO, 2021a). These arrivals for March 2021 are, in fact, 88 per cent below that those levels in March 2019.

By May 2021, the figures seem to only worsen. Compared to the first five months in 2020, this year in 2021, the sector witnessed around 85 per cent fewer tourist arrivals. The figures for May somewhat recovered due to a slight opening in travel during the month, however, overall, the situation remains the same. Asia-Pacific still remains the worst affected region with a loss of 95 per cent of tourist arrivals from January-July 2021 as compared to the same period in 2020. Following the trend, Europe was the second with 85 per cent decline. The figures for the Middle East worsened as the decline increased to 83 per cent, while Africa witnessed 81 per cent fall (See Figure 1). The Americas, however, saw only a slight increase from last year, with over 72 per cent fall in tourist arrivals (UNWTO, 2021b).

4.1. Aviation segment

The airline industry was amongst the first to come under the radar of the pandemic-led economic slowdown. As soon as the virus was declared a pandemic by the World Health Organization (WHO), the aviation sector witnessed cancellations in huge numbers. The months that normally account for a vacation period for those in the Asian region, given the start of the season with the Chinese New Year, witnessed the entire world enter into strict lockdowns. For the aviation industry, it meant that the airlines would not be allowed to commercially operate unless authorised by the government of the nation as well as the destination country. This marked the first step towards the halt of the services in the aviation sector for an uncertain period of time.

Given that the world was under complete lockdown during the months of March and April 2020, worldwide almost 60 per cent of the commercial flights were grounded. Since the future of travel was uncertain and there was no clarity as to when it be safe to travel as well as what would be the procedures one would have to follow while travelling, no new bookings took place in the first few months of 2020. All over the world, the bookings dropped by over 80.4 per cent with, 98.2 per cent drop in the Asia-Pacific region alone. Even after the lockdowns were lifted and economies started reopening their activities, the bookings did not increase. The airlines started offering huge discounts to the passengers, but in vain (Pearce, 2020).

The Chinese economy has gained significant market share in the travel and tourism sector and has emerged as a major player. So much so, that any change in the travel and tourism sector within the Chinese borders, would leave a huge mark on the global tourism economy (Moon, 2018; Xinhua, 2019). Therefore, the closure of Wuhan airport in January and subsequently entire China, made the entire sector vulnerable and resulted in a sharp decline

in the global revenue passenger kilometres (RPKs). The decline in RPKs started with 52.9 per cent year on year in the first quarter of 2020 and attained its peak at (–)94.3 per cent year on year by April. Some marginal improvements were recorded in the month of May 2020 when the RPKs stood at (–)91.2 per cent year on year. This small improvement was due to the recovery of domestic markets in China, Vietnam, New Zealand and South Korea. It raised the hope of the industry experts that a domestic tourism led recovery could be witnessed by the end of 2020. The location of these countries in the Asia-Pacific region also suggested that the region which was the first to bear the consequences of the pandemic would be the first to recover from it (IATA, 2020a). There were also expectations of the European markets reopening and tourism gradually recovering. An overview of the situation in the airline industry with respect to the RPKs is as follows.

The situation of air travel continued to improve throughout the summer months, with RPKs improving from 79.5 per cent in July to 75.3 per cent in August 2020. The air travel recovery, which supposedly started in May 2020, was struck by the resurgence of the virus and by the end of the fourth quarter, the industry witnessed a 69.7 per cent year on year decline in RPKs. Similar declining figures were last witnessed by the sector in the 12 months after the 9/11 terrorist attacks in the US. The recovery was, however, delayed by the second-wave that struck the world and especially major parts of Europe, Asia-Pacific and America. Europe introduced stricter lockdowns along with new travel restrictions. This led to a weakening in the growth in RPKs in the third and fourth quarters of 2020 (See Table 1). Consequently, in the months of September, October and November, the RPKs stood at 72.2, 70.6 and 70.3 per cent, respectively. The rebound in the sector was expected to occur via the domestic markets, however, by the end of the year, recovery across both domestic and international markets came to a halt.

Table 1
Region-wise breakdown of changes in Revenue Passenger Kilometres

Region	RPKs April 2020 (% change Year on Year)	RPKs November 2020 (% change Year on Year)	RPKs July 2021 (% change Year on Year)	Passenger Revenue 2020 (USD billion vs 2019)
Asia-Pacific	– 50	– 61.6	-62.7	– 113
North America	– 36	– 67.6	-28.5	– 64
Europe	– 55	– 82.2	-56.5	– 89
Middle East	– 51	– 84.5	-73.2	– 24
Africa	– 51	– 75.6	*	– 6
Latin America	– 49	– 59.8	-44.5	– 18
World	– 48	– 70.3	-53.1	– 314

* implies that data is not available for that country in the specified period.

Source: IATA Economics, *Air Passenger Market Analysis, April 2020; November 2020, July 2021*.

Across the world, air travel in all regions seemed to be equally impacted by the outbreak of the virus. Overall, the Asia-Pacific region witnessed the worst decline, as for the month of December as well, the RPKs continued to show a decline of over 95 per cent year on year. Stricter lockdowns and containment measures in light of the second wave, deteriorated the recovery of air travel in Asia-Pacific even further. The Middle Eastern region witnessed the sharpest decline in RPKs of 72.2 per cent in the entire year, with 83 per cent year on year in December 2020 alone. This was because the region acts as a major connecting point for

international long-haul routes, which remained largely closed the entire year and did not show any signs of recovery (IATA, 2020b). The European region recorded an 82.3 per cent decline in December which was better than previous months. This recovery was due to the upcoming holiday season, but was reversed with the occurrence of new mutants and variants of the virus.

The upcoming new year of 2021 arrived alongside the outbreak of new variants of the disease-causing an even worse situation for the air travel industry. In January 2021, world air travel witnessed a 72 per cent decline in RPKs as compared to the levels in January 2019. The decline was driven by the domestic markets, which in some months in 2020 were considered a key driver of recovery of the industry. Major deterioration could be attributed to the closure of and decline of domestic markets of Asia especially, China, Japan and Australia, which were the key markets driving the industry towards recovery (IATA, 2021a). The new COVID-19 cases grew viciously in most regions of Europe and America, adding to their distress. The restrictions in the Asia-Pacific region were way more stricter during this time, which added to their share of the decline in RPKs.

The situation improved for the month of February 2021, with domestic markets of India, Australia and the US driving the RPKs in an upward direction, while the Chinese domestic market continued the downward trend (IATA, 2021b). The rebound, which started in the month of February, continued throughout March and April with the resilience of the domestic market and increasing pace of vaccination being the driver of consumer and business confidence. Surprisingly, by May, the domestic markets of China and Russia had recovered to their pre-crisis levels, which acted as a major push to the global RPKs, showing a recovery for the fourth consecutive month (IATA, 2021c). By July, international travel also started its journey on the recovery path (See Table 1). The demand for travel was boosted due to consumer willingness and confidence to travel. However, the emergence of a new wave of the delta variant in Australia and China put a dent on this recovery. Africa and Middle East regions continued to recover owing to the vaccination and eased travel restrictions. The European region, however, emerged as a pioneer in August, with RPKs down by only 55.9 per cent as compared to 2019. The Asia-Pacific region continued to be the worst performer, especially with the eruption of the Delta variant in the Southeast Asia region. For most of 2021, the American region performed well, with travel boosted between North and Latin America (IATA, 2021d).

One of the biggest challenges for the airline industry in the entire fight against the pandemic has been the pressure to control their cash burn up to the time when demand recovers. Ideally, an airline has adequate cash for surviving two months of stagnant demand. However, with the declaration of travel restrictions in the year 2020, the airlines already witnessed a cash burn of almost USD 51 billion in the second quarter of 2020 itself. Since almost the entire world was into lockdowns and most destinations had sealed their borders, the airlines had to refund the tickets for a majority of passengers. Low demand, millions of livelihoods to sustain, and an uncertain unprecedented future added to the misery of the aviation sector. The second quarter of 2020 turned out to be the worst time for the airline industry, however, some cash recovery was also observed. Even then, the experts believe that the cash burn is likely to increase by over USD 75 billion between quarter four of 2020 and the first half of 2021 (IATA, 2020c).

4.2. Hotel and Accommodation segment

The travel industry and the hospitality sector are intertwined in such a manner that any issue in the former has a ripple effect on the latter. Once travelling was suspended worldwide in the first quarter of 2020, the activities and business in the hospitality sector, especially the hotel and accommodation segment, were significantly affected. The suspension of travel meant zero new bookings as well as negligible or low occupancy of pre-paid hotel rooms. The shift of businesses on to an online medium, further hampered the hope for a recovery in the near future. The MICE segment became the first to come under the radar of the pandemic-led restrictions on travel and shall be the last to recover.

By the month of March 2020, the hotel segment had witnessed an almost 111.1 per cent decline in global revenues per available room (RevPAR) in the Asia-Pacific region alone. In Europe, the loss of global RevPAR was around 61.7 per cent, while the Americas, especially the US hotel industry, had the highest fall with a loss of over 159.9 per cent of global RevPAR. The month of March proved to be the roughest for the hotel segment in the Middle Eastern region. They faced an overall 167 per cent fall in occupancy rates. Their revenues had started declining early on as they recorded around 7.9 per cent and 23.2 per cent fewer average daily rates (ADR) and RevPAR even before the pandemic attained its peak (STR, 2020a). As the months progressed and stricter restrictions came into place, the occupancies and the revenues thereof, deteriorated even further. In May 2020, the hotels in Canada recorded only 16.6 per cent occupancy, leading to a loss of ADRs by 37.5 per cent and RevPAR by 84.9 per cent. Similar losses were recorded in Australia as well, when the hotels in Melbourne witnessed only 28.8 per cent occupancy by the first week of May. Their losses declined by 32.8 per cent in terms of daily revenues and 75 per cent in terms of RevPAR.

In a change of events, interestingly, the deteriorating situation in the hotel segment worldwide did not start with the arrival of the pandemic. The hotel industry in the European region has been suffering from low occupancies and declining revenues since 2019. After witnessing a year of bad revenues, the hotel industry was set to witness some recovery in 2020. However, the emergence of the pandemic, in the first quarter of 2020 itself, was like a major shove in the opposite direction. By the time April 2020 arrived, the European hotel segment recorded 84 per cent fewer occupancies as compared to 2019 April. Similar losses were recorded in Asia-Pacific and Middle Eastern region for the month of April, with occupancies down by over 60 per cent, 58 per cent, respectively. Africa, however, witnessed only 10 per cent less occupancies by this time, as compared to the same time in 2019. Interestingly the situation of the hotel segment in the Americas, especially the US was not that bad. One of the reasons for this was the decision of the Trump-led government to not impose a complete lockdown on daily activities. The figures recorded by this region were although lower than those in 2019, but the picture was still better than what the other regions were witnessing.

The hotel and accommodation industry witnessed severe fluctuations in occupancy rates and revenues throughout the year 2020. The magnitude of the losses did not remain constant for all the regions at all the time. For instance, in August, the Asia-Pacific region recorded only 30 per cent fewer occupancy rates as compared to 2019. In fact, the region was witnessing an occupancy rate of over 50 per cent by August 2020. This was majorly due to the rebound witnessed in the domestic markets of Mainland China, Japan, Australia and New Zealand

and some parts of India, mainly due to national holidays and Mid-Autumn festival (Hospitality Trends, 2020). These countries recorded an occupancy rate of 64.2 and 23 per cent for the month of August 2020. It should also be noticed that within the regions as well, different countries recovered differently. This is because every nation had its own vaccination roll-out plan and containment measures (STR, 2020b). Strong domestic demand was witnessed in major parts of Asia-Pacific, which resulted in an improved performance by the region. For the month of November, Asia-Pacific recorded an overall 50 per cent occupancy rate with daily revenues only 23.6 per cent down that 2019 and RevPAR owned by only 43.3 per cent (STR, 2020c).

The regional analysis of the hotel segments shows that there has been a declining trend in the occupancy rates (See Figure 3a); average daily rates (See Figure 3b) and the revenue per available room (See Figure 3c) since 2018. Since the start of the pandemic this fall has only increased, with Europe coming out as the worst-performing region in terms of occupancy rates and RevPAR. This is because of a few policy decisions taken by the countries in the region. For instance, the European region eased up their regulations, and travelling increased significantly during the summer season. Paradoxically, the turnaround came when the second wave of the virus hit Europe and severely impacted the lives of those in the region. The occupancies fell by 51.7 per cent, daily rates by 27.2 per cent and RevPAR by 64.8 per cent, respectively. The occupancy levels in September were the lowest on-record occupancies ever witnessed in Europe (HN, 2020). As a result, the government re-introduced stricter lockdowns and border closures, making Europe the worst-performing nation by November 2020 with occupancy rates down by 70.4 per cent, loss of daily rates of 32.3 per cent and RevPAR loss of over 81.2 per cent. The year for the hotel segment in Europe ended with hotels recording only 33.1 per cent occupancy, with revenues per available room down by 62.5 per cent. The African region, however, emerged as the least affected region. The situation in the US had also deteriorated by the time the year ended. Due to the lack of precautionary lockdowns and restrictions on movement, the hotel industry in the US had over 1 billion unsold rooms. These levels were even lower than those witnessed during the recession of 2009 (Airoldi, 2021).

Figure 3a

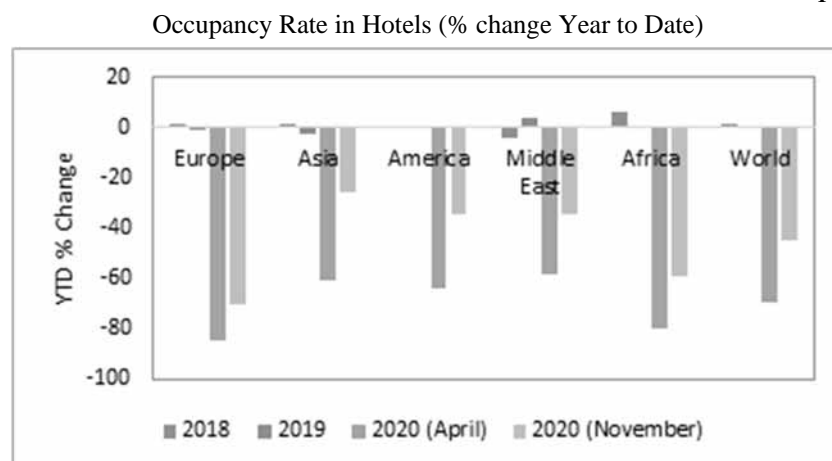


Figure 3b

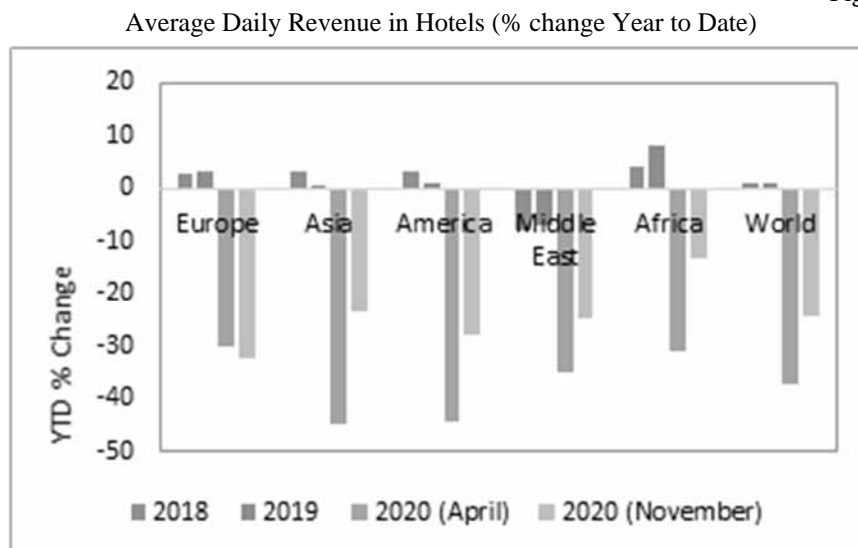
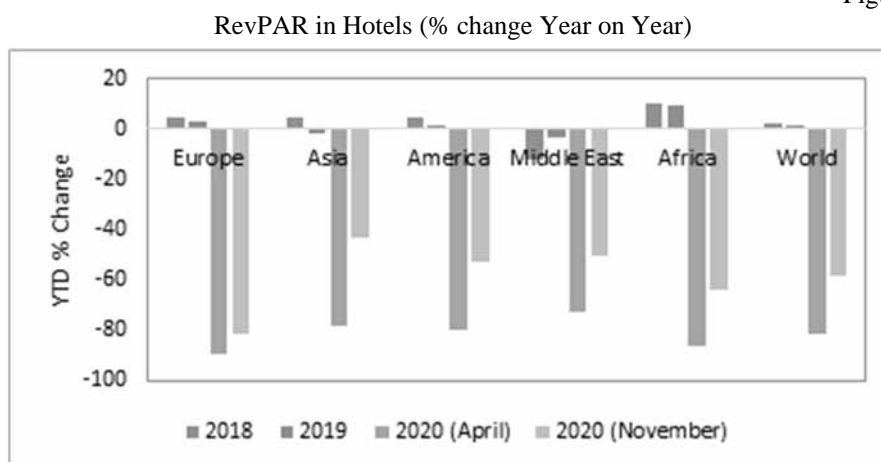


Figure 3c



Source: STR Global Hotel Review (Media Version) 2018; 2019; STR Press Releases, 2020.

The emergence of the delta variant of the virus disrupted the meagre recovery that was being made by all the regions, if any. The recovery of the hotel segment was majorly driven by domestic demand. In an interesting change of events, the Asia-pacific region, which was the first to get impacted by the outbreak of the virus, had shown several signs of resilience and ultimate recovery of markets. In fact, China, the country where the virus outbreak initially began, became the driver of global recovery. The summer vacations of Mainland China, led to an overall upward trend in occupancy rates and by July 2021, the country was set to achieve the levels of occupancy last witnessed in 2019. The RevPAR index of the country went from

87 to 117 by the end of July 2021. A similar recovery was witnessed in India, where the alternative accommodation services and the luxury hotels segment were witnessing an increase in demand. India witnessed an explosion in demand for domestic leisure leading to an increase in the number of bookings by July 2021 (STR, 2021a).

4.3. Tourism dependent MSMEs

The tourism sector is characterised by a large number of Micro, Small and Medium Enterprises. These MSMEs are often owned and operated by resident families and are a significant feature of tourism-dependent countries or developing nations. These may have several types, such as, rental accommodations, small cafes and restaurants, tour operating services, local shops in the market especially selling souvenir goods, among others. Due to their size and scale of operation, MSMEs do not have enough financial buffer to survive a shock (UNCTAD, 2021). They are highly interdependent as well. This, therefore, leads to a ripple-like effect in the entire ecosystem whenever one segment faces a crisis. They even lack the flexibility and alternate options which the larger firms in tourism have access to and are therefore not resilient enough. Additionally, the seasonality of their business is one of the major reasons that these firms are the first to succumb to the economic and financial crunch created by any crisis.

Interestingly, the sector has a significant contribution towards employment generation as well. A large portion of the activities here are informal in nature and employ a large number of migrants, young people, women and semi or less-skilled workers. It is an important source of livelihood for almost 80 per cent of the tourism sector (Babu S, 2020). Many of the MSMEs entered into the pandemic with an existing weak financial and economic structure. The lockdowns imposed to curb the spread of the deadly virus, therefore, had a much severe impact on the functioning of these businesses. Since March, travelling had completely come to a halt, implying no new bookings were made for flying, nor hotels, cafes, recreational activities and other tourist attraction activities. This further meant that there was no requirement of transportation for tourists, nor tour operators, tour guides, local shops and the like. This inactivity led to major insolvency and bankruptcy problems for a lot of MSMEs. As a result, a large portion of the businesses shut down within the first few months of 2020, failing to pay their debts and coping with the economic stress. The workers employed in this segment faced the direct impact of the shutting down of the businesses. They not only lost their jobs but were forced to switch sectors or opt for jobs in the over-burdened agriculture sector.

The socio-economic crisis created by the pandemic was not limited to the MSMEs alone, but also spread to large firms operating in similar businesses. The financial burden created due to prolonged periods of inactivity and disrupted supply chains changed the financial and economic outlook of the entire sector. The businesses, therefore, had no other option but to wait for the stimulus packages announced by their governments to help them come out of the crisis. The recovery for the segment would be quite strenuous, but timely handling of loans and dealing with financial stress shall be critical for the recovery of the segment (UNCTAD, 2021).

5. Towards the Next Normal

The tourism sector is highly resilient and always bounces back after any crisis. The evidence from past epidemics and pandemics reveal that sooner or later, tourism returns back to its status quo (Papatheodorou, et al., 2010; Novelli, et al., 2018). However, such shocks to the demand and supply side, often lead to a shift in the functioning of the businesses. The current pandemic is believed to cause such a shift in the market behaviour and change consumer perspectives by changing the travel patterns globally (Irwin, 2020; Ioannides, Gyimóthy, 2020). It is one of a kind and nothing of such a magnitude had been experienced before. Therefore, it is obvious that the pandemic shall leave a huge impact on the world. The outbreak of the disease forced people to stay indoors for days at length. The inactivity for such a prolonged period had both positive and negative effects on both lives and livelihoods of people globally. On the one hand, humans staying indoors gave nature time to replenish and heal from all the harmful actions of humans that led to its disruption and depletion. The world witnessed a few signs of recovery of nature in the form of healing of the ozone layer, better air quality around the world, lesser pollutants in rivers and oceans and the like. On the other hand, millions of people lost their livelihoods. Others were either struggling with the shift from physical jobs or unable to meet the expectations of the new world that was shaping itself to be completely technologically driven.

The tourism sector has faced the severe brunt of the pandemic-imposed lockdowns, and businesses have struggled to survive. This led a lot of businesses to come out with innovative, workable solutions. For instance, virtual tours became more popular during the first year of the pandemic. The comfort and convenience of the consumer became a priority, with hotels in Japan even substituting robots at receptions for helping with contact-less bookings. The tour planners have become more mindful in their marketing policies as well. Areas with open space, decluttered accommodation, contact-less interactions with the staff and utmost attention on health and hygiene are becoming the major highlights. Curating a tour in a futuristic way has become a major attraction for consumers (Sanand, 2020). The floating islands of Copenhagen, custom boutique stays in Greece, yachting and liveaboard in the Maldives, among others, have attracted a lot of tourists during the pandemic (Menezes, 2020). In this way, ecotourism is also expected to boost tourist activity in the recovery phase of the sector (Ocampo, 2020).

The next normal will involve more mindful and cautious travel. The light at the end of the tunnel is the opportunity that the pandemic has presented in the form of restarting economic activity (Sharma, et al., 2021). In the context of tourism alone, the pandemic and the inactivity of the sector, gave those within tourism time to stimulate and cultivate future actions within the sector in a more sustainable fashion (Neiwiadomski, 2020; Romagosa, 2020). The goals of sustainable development have become more important now, than ever. In today's time, it is imperative for a business to be innovative and sustainable for its survival in the market. Tourism also has to be rethought and policies have to be made keeping in mind both innovation for attracting business and sustainability for long-run survival and environmental health.

The pandemic has indeed changed the future of travel. The emergence of the delta variant and other mutants of the virus, will make travelling more of a luxury, and consumers more

demanding. The way to restore consumer confidence and boost the demand in the tourism sector will be by putting safety first. The increasing pace of vaccine roll-out prompts that the situation of global tourism in 2021 is much better than that in 2020 when the vaccines were still under trial runs. Unfortunately, the progress of vaccination has been slow in major parts of the world, putting millions of workers in the sector exposed to the virus and thus affecting the supply side. On the demand front, the existing travel restriction imposed by different countries and its ever-changing status in light of the new variants of the virus has added to the distress of plans to travel. Several destinations have added a mandatory PCR test to their COVID-19 protocols, adding much to the inconvenience of the travellers. High costs of the tests, unclear travel regulations, uncertain change and cancellation of flights, evolving protocols and limited international coordination has all affected the plans of travel (IMF, 2021).

From the consumer's perspective, there are three key determinants to be kept in mind while planning to travel. These include, the location, the price and the reviews of the destinations with a special focus on the hygiene and sanitisation facilities. At the same time, the transformation of work from a physical mode to an online one and the preference of work from home in the current time, has boosted a major demand for accommodations with proper internet connectivity (STR, 2021b). In the future, short-haul travel would become a prominent feature of travel. People would prefer travelling within their country and exploring domestic tourism. Interestingly, luxury travel is booming and shall remain one of the key drivers of the recovery of the industry (Dombey et al., 2021). Furthermore, the cancellation policies of airlines as well as the hotel and accommodation services will play a crucial role in the decision to travel. The use of automation technology, artificial intelligence and ease of digital devices for maintaining proper COVID-19 related health measures will not only boost the confidence levels of the consumers, but also help the businesses save some increased expenses due to the pandemic (Assaf & Scuderi, 2020).

There is a long way ahead on the path of recovery of the tourism sector globally. Although in a few countries, tourism has already been restarted, due to its global supply chain, the supply side is still witnessing disruptions. The stimulus and relief packages announced by the respective governments for the sector are proving to be helpful and there is a lot of talk about changing the very essence of tourism towards a more sustainable system. However, before any of this happens, it is important to restart the sector as millions of livelihoods are getting affected and billions of dollars are being lost in terms of revenue, every passing day.

6. Concluding Remarks

The COVID-19 pandemic turned out to be the biggest humanitarian crisis the world has ever witnessed. It emerged as a shock and disrupted the global supply chain, putting various sectors into distress. The inactivity for the first few months of 2020 led the world towards a recession that was bigger than that witnessed during the financial crisis of 2008-2009. Although all the sectors across economies came under the radar, the tourism sector was the first to feel the brunt of the lethal virus. The restrictions put in place by most of the nations,

as a non-pharmaceutical intervention to stop the spread of the disease, resulted into an unprecedented fall of the global tourism sector.

Tourism is a multi-dimensional industry that affects the performance of many sectors. The current pandemic crippled the sector and froze the global tourism supply chain. The impact was far-fetched, affecting millions of workers worldwide. Amongst them, migrants and informal workers, especially women and youth, were the worst affected. The standstill of activities within the tourism sector, displaced millions, while also increasing their vulnerability and susceptibility to poverty and lack of social security.

There have been variations in the momentum in which the pandemic affected tourism across the regions. The first region to suffer the consequences of the pandemic-led travel restrictions was the Asia Pacific region, where the virus first emerged. Across all the associated segments, the Asia-Pacific region continued to be the worst-performing region throughout the timeline of this study. There were, however, months where Europe replaced Asia-Pacific in poor performance. Interestingly, all regions took turns in performing poorly. The performance of the tourism and its allied sectors were guided by a few factors, such as the location with a greater number of active confirmed cases, the restrictions and measures adopted for combating the spread of the virus, rules and regulations regarding movement of people, medical, hygiene and sanitisation services available in the area, the rate of vaccination and the pace of PCR tests. As and when any region experienced a change in the implication of these factors, the performance of the tourism sector of that region changed. This is evident from the case of Europe, where before the second-wave struck the continent, travel restrictions were low and tourist arrivals improved, with air travel, hotels and local businesses witnessing recovery. Similar instances were found in Asia, where China, South Korea, Japan and Australia witnessed some recovery in tourist arrivals, with hotel occupancy rates in some cases returning back to pre-crisis level. In the American region, especially the USA, the impact at one point of time was severe, as the confirmed cases were increasing since the country did not implement any major travel restriction. By September 2020, travelling had resumed in parts of Europe, China, Vietnam, Australia and Japan. However, the emergence of the second wave of the virus changed the scenario once again.

The emergence of new variants of the virus and associated infections such as black fungus and yellow fungus, further deteriorated the recovery of the sector. Tourism continued to perform poorly in the first quarter of 2021 as well. However, with the increasing pace of vaccination, several destinations eased their travel restrictions, giving the tourism sector a window to restart its recovery. Thus, in March and April 2021, several countries around the world witnessed a surge in their tourism activities. Paradoxically, domestic tourism led the sector to its recovery path. Consumer confidence and business confidence levels continued to improve in 2021 as a result of coordinated efforts by the regulating authorities and the government stimulus packages. International tourism is, however, still lagging behind. Increasing numbers of factors such as costs of tests, unclear rules and regulations, lack of coordination with authorities at the destination, ground-level COVID situation, access to hygiene and sanitation facilities, among others, continue to affect the decision to travel.

Lastly, for the recovery of the global economy, it is important that tourism is restarted. The disruption brought about by the halt of the movement of people, has resulted in a catastrophic

impact. Millions of livelihoods dependent on tourism have suffered an irreversible loss. The revival of the sector, however, cannot be made in the traditional way. The sector needs to undergo the transformation and become more sustainable. Although the sector is resilient and sooner or later returns back to the pre-crisis level, the sector needs to be mindful and build itself on the pillars of innovation and sustainability.

The study was conducted at a time when the world economies have been restructuring themselves and taking major policy decisions to survive the pandemic-led crisis. Therefore, the study has conducted a regional analysis by segregating the world into five regions. Due to the limited availability of information and real-time data, the reports and data considered here are of a limited time period and may reflect some time lag. The tourism sector needs coordinated action from governments, regulatory authorities, local communities and industry players. Certain major policy decisions have been taken and as and when the spread of the virus is controlled and nations ease their travel restrictions, the effect of the policy decisions will be reflected. Therefore, the study is limited to analysis of the tourism sector and its interconnected sectors, viz. aviation, hotel and accommodation and MSMEs in tourism-related businesses. Future studies may be directed towards a country-wide analysis and may consider a longer-time period, based on the data availability.

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comparative analysis and carry out predictive calculations of the volume of migration increase (decrease) in Ukraine.

Keywords: migration; migration movement; migration increase; emigrants; immigrants; multivariate econometric model; scenarios; Covid-19

JEL: C82; F22; F24; J11

1. Introduction

Changes in geopolitical globalization, production internationalization, international economic and political integration and world migration processes' intensification cause the international mobility increase of the Ukrainian population, including women and men, minors, and highly qualified specialists. Record migration flows with all countries taking imbalances of the labour force in various labour markets. However, with quarantine activities background triggered by the Covid-19 epidemic and the lockdown imposed by many countries (restrictions on movement and communication among countries) and a decline in economic activity worldwide, some migration processes connected mainly with the migrant workers inbound. The mentioned reasons enforce to regulate such processes and provide them with a well-maintained and non-conflict character. Therefore, state regulation on a favourable and sustainable social and economic development of the country, minimizing pandemic and economic crisis, is vital, especially at the national level. Hence, national job creation issues address time to prevent migrant workers from leaving, as the workforce is the propulsion behind that crisis. Ensuring state regulation of migration processes is a complex task that requires an integrated and systematic approach.

2. Literature Review

The World Bank Grope (World Bank Grope, 2020) appraised the economic crisis impact caused by Covid-19 through the migration perspective, namely global trends in international economic migration and remittances in 2020 and 2021. When considering migration processes, the economic crisis could extend, deepen, and get pervasive, as global economic activities almost got a standstill with imposed travel bans and social distortion. Host countries face challenges in many sectors, like health and agriculture, which depend on migrant workers. Migrants face the risk and possible loss of employment, wages, and health insurance. Therefore, relevant public authorities should address such processes at the national level.

Policy Strategy of Ukraine's State Migration up to 2025 (Verkhovna Rada of Ukraine, 2017) aims to direct state and society's efforts towards forming and implementing the state migration policy. Which on the one hand, positively affected Ukraine's consolidation and its state security, accelerated social and economic development, and, on the other hand, contributed to a slowdown in depopulation, becalming quantitative and qualitative population aspects, meeting the economy requirements in labour, corresponding both with international standards and obligations of Ukraine.

Furthermore, this strategy focuses on migration problems, direct society to tackle them, ensures the migration policy relationship with other areas of the country's activity, and shifts

from a response policy concerning internal and external migration factors to a more active and targeted policy.

Both local and international scientists study migration trends at the national and international levels, particularly the theory of global and regional migration processes, migration flows in OECD countries, aspects of asymmetry in migration processes, and economic research on immigration determinants. For instance, provided by an overview of existing economic theory and empirical data to assess the likelihood of migration flows from neighbouring countries to the EU states (Borjas, 1999), allowing to make recommendations on Migration policy to avoid serious problems arising in the migration in the European Union. Economists and economic historians (Hatton, Williamson, 2005) examined two centuries of global mobility, assessing its impact on migrants themselves, on sending and receiving countries, and also conducted a comprehensive economic assessment of mass migration from a long-term historical perspective, including migration from north to north, south to south and south to north. Other scientists (Karemera, et al., 2000), in their study, analyzed the influence of political, economic, and demographic effects on the size and structure of migration inflows to North America. Proved that an increase in migration with low ability than high capacity movement leads to a decrease in migrants' expected wages at the destination, hindering high capacity migration (Katz, Stark, 1984). Empirically investigated the determinants of migration flows in fourteen OECD states by the country of origin, analyzing the impact on the movement of average income and income dispersion in the countries of destination and origin, the influence of geographic, cultural, and demographic factors and the role that changes play in the migration policies of destination countries (Mayda, 2009). Based on the analysis, we presented forecast models of international migration.

Quite a few works are devoted to studying theoretical and applied aspects of migration processes in Ukraine. In particular, reviewed the challenges and threats that caused massive interregional and interstate population migration movements in some areas of Ukraine (Dacko, 2014), general methodological approaches to studying the risks of modern migration processes to the country's national security in theoretical and practical aspects, and implementation of the state migration policy measures to prevent them and the resolve them when they appear. Determined the labour migration impact on the development of Ukraine's labour market by assessing labour migrants' earnings and remittances (Maidanik, 2019), allowing to develop proposals for the migration policy formation and improving labour migration statistics. Substantiated and defined conceptual approaches, directions, and mechanisms for improving Ukraine's external migration management based on the migration analysis and the evolution of the management activities after generalizing international, mainly European, experience (Malinovskaya, 2013). Assessed the impact of modern trends in external labour migration on Ukraine's long-term social and economic development, particularly a quantitative estimation of the process's outcomes (Poznyak, 2016). By studying the development of global demographic processes (Sardak, et al., 2018), defined their appearance, manifestations, implications, and prospects for spreading in the first half of the 21st century. With worldwide Covid-19 and quarantine activities impose, several scientists devoted their work to study the impact of Covid-19 on migration and national economies. In particular, discusses the impact of activities related to curbing infection (Michie, 2020). Developed the migration model and intensity of travel based on human mobility analysis and

coronavirus infection (Sirkeci, Yucesahin, 2020). Carried out the risk management analysis (McAleer, 2020), of social and economic consequences of the pandemic (Nicola, et al., 2020), of the influence of Covid-19 on society and the world economy (Chakraborty, Maity, 2020). However, aspects of migration processes in Ukraine require additional research. It is necessary to study the impact of the demographic and socio-economic development of the country, living standards, education and employment of the population during the global Covid-19 pandemic on migration processes.

The article is aimed at modelling migration changes according to alternative scenarios, using the example of Ukraine. This makes it necessary to analyze the main factors affecting the migration processes of Ukraine: population size, life expectancy, GDP per capita, average monthly wages, and the volume of remittances of individuals to Ukraine.

3. Methodology Data description

For the study, the results of scientific works of leading scientists were studied and summarized in terms of the main factors affecting migration processes. Taking into account the constant decrease in the number of residents of Ukraine and the change in their life expectancy, the share of the economically active population (persons aged 15 and over) has decreased. This influenced the decrease in GDP per capita. The global Covid-19 pandemic has caused the need to introduce quarantine measures related to restricting movements. This led to the return of labour migrants to their homeland. Labour migration in Ukraine is mainly related to wages, which are significantly lower than the average level among European countries. This significantly affected the volume of remittances. This made it possible to identify a number of factors influencing migration processes and between which there is a correlation dependence. Using the statistical method of multiple regression, a multivariate econometric model of the dependence of migration growth (decline) on the selected indicators is calculated. This made it possible to simulate migration changes according to alternative scenarios.

4. Research Results

The methodology of theoretical justification and migration management in the current conditions requires a comprehensive approach to the analysis of the nature of migration being in its entirety and those economic, social, legal, and other factors inherent for this particular period, as well as its causes, and subjects of migration, and the methods of its regulation. The theory of controlling the population migration movement (Veselskaya, 2017) provides an understanding of migration as a specific way of being, functioning, and developing determinants and mechanisms of migration, types of migration needs and interests, and the features of their formation and achievement.

However, in reality, the main reasons for changing the migration process are Covid-19 and other global pandemics, as they directly impact restricting people's moving across borders. Besides, 179820 people have lost their jobs since introducing quarantine measures related to Covid-19, which is 1.73% of the officially employed people. Simultaneously, 122451 people

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have formally been unemployed since the quarantine began, making 25.37% of the country's official unemployment. Since the beginning of 2020, the migration balance in Ukraine has remained positive. As of 14 May 2020, 135509 more foreigners left the country than entered, and 489153 more Ukrainians left the country than arrived due to the economic consequences of the Covid-19 quarantine. Quarantine measures have also affected remittances in Ukraine, namely, as of 31 March 2020, remittances to the country amounted to 921.9 million USD that individuals had transferred 504.7 million USD via international payment systems, which is 16.31% less than of 31 December 2019 (remittances via global payment systems decreased by 21.73%). Equal significance has had a negative difference between the amount of currency sold by the population and the amount bought by banks from the community since the country's epidemiological restrictions. That means that the population has sold more foreign currency than bought, i.e., the population spends the saved money on their priority security, leading to social tension and has to turn to borrowed funds. The attraction of credit funds by individuals has increased by 5.57% since the beginning of 2020, with 35.3% of non-performing loans.

Ukraine migration has different effects on its demographic development, participation in the international labour division, access to European and world markets, and social and national security. Hence, Ukraine's main strategic tasks are maintaining state sovereignty, territorial integrity, integration into the European economic and migration scope, ensuring close to world standards of quality and life expectancy, and realizing citizens' rights and freedoms (Table 1).

Table 1

Dynamics of structural indicators of migration processes in Ukraine

Indicators Years	Population (thousand people)	Births number per 1000 residents	Death number per 1000 residents	Average life expectancy and males at birth, years	Interstate migration		
					Emigrated people	Immigrated people	Migration growth, reduction (-)
2011	45778.5	11.0	14.5	71.02	14588	31684	17096
2012	45633.6	11.4	14.5	71.15	14517	76361	61844
2013	45553.0	11.1	14.6	71.37	22187	54100	31913
2014	45426.2	10.8	14.7	71.37	21599	42698	21099
2015	42759.7	10.7	14.9	71.38	21409	30659	9250
2016	42584.5	10.3	14.7	71.68	6465	14311	7846
2017	42386.5	9.4	14.5	71.98	20234	28360	8126
2018	42153.2	8.7	14.8	71.76	24252	39307	15055
2019	41902.4	8.1	14.7	72.01	26789	45011	18222

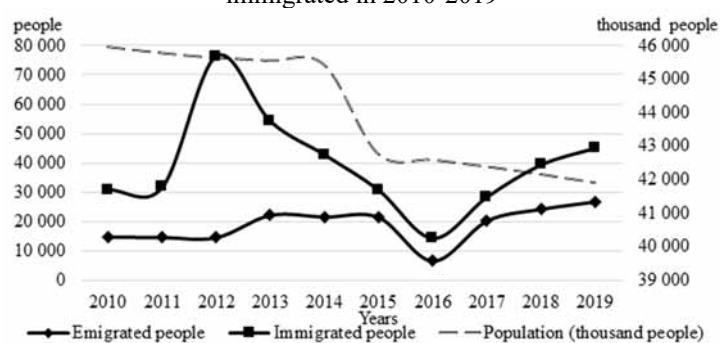
Source: authors' development based on (State Statistics Service of Ukraine, 2020a).

It should be noted that the average life expectancy in Ukraine in 1991 in Ukraine was 69 years, and already in 2019 - 72.01. At the same time, life expectancy for men increased from 64.6 years (in 1991) to 66.9 (in 2019). Life expectancy has increased from 74.2 years (in 1991) to 76.98 years (in 2019). The difference in life expectancy between women and men is observed throughout the territory of the former Soviet Union. In Europe, the difference in life expectancy between women and men is 4-5 years. So far, due to an ageing population and a low birth rate, Ukraine is rapidly approaching a demographic crisis, which will have

consequences in the economic sphere, due to a decrease in the volume of the domestic market and the number of the labour force.

According to (SMSU 2019), in 2018, Ukrainian citizens were issued 8551 permits to travel abroad for permanent residence, 1634 citizens returned to Ukraine. Immigration relations are an essential component of migration. Figure 1 shows the dynamics of the current population and the number of persons who emigrated and immigrated in 2010-2019.

Figure 1
Dynamics of the current population and the number of persons who emigrated and immigrated in 2010-2019



Source: constructed by the authors on the basis of the data (State Statistics Service of Ukraine, 2020a).

The dynamics of the available population has a steady downward trend and develops according to a linear relationship with an approximation level of 0.8687:

$$y = -543.81 \cdot x + 47005. \quad (1)$$

This allows us to make a forecast and assert that if we do not take measures to reduce the number of Ukrainian citizens travelling abroad, then by 2025, the population in the country will decrease by another 5 million and will amount to about 37 million people.

The dynamics of the number of persons who immigrated develops according to a polynomial dependence of the 5th degree with an approximation level of 0.8039. With the preservation of such dynamics in 2025, there will be about 19.5 thousand immigrants, which is explained by the possibility of employment with better wage conditions in other countries than in Ukraine.

$$y = -74.286 \cdot x^5 + 1977.1 \cdot x^4 - 18416 \cdot x^3 + 69940 \cdot x^2 - 94606 \cdot x + 69652. \quad (2)$$

The dynamics of emigrated persons develops according to a polynomial dependence of the 6th degree with an approximation level of 0.7268 and, according to forecasts, in 2025, this indicator will be 4 thousand people:

$$y = -8.8531 \cdot x^6 + 262.54 \cdot x^5 - 2908.6 \cdot x^4 + 14924 \cdot x^3 - 35942 \cdot x^2 - 38204 \cdot x + 337.67. \quad (3)$$

Such processes are demonstrating intensive growth rates and are becoming less and less predictable. There is an emigration of persons from developing countries to developed countries. In parallel, the immigration of unskilled labour from even poorer countries is taking place, which creates a number of additional problems. They must be tackled immediately, as this could lead to the collapse of Ukraine as a whole.

The most significant number of immigrants are citizens of the former Soviet Union countries and have preserved kinship and territorial relations with Ukrainian citizens. We should note that most migration declines (ingoing people more than outgoing) in the USA and Germany, while migration grows (outgoing people more than ingoing) is in African countries, Russian Federation, and Turkey.

Studies of interstate migrants by age groups and sex (Table 3) showed that most of all men aged 15 to 29 arrived in Ukraine – 18,598 people, which is 60.43% of the total number of male arrivals. The number of women leaving is two times less. Men between the ages of 20 and 29 are leaving the country en masse - 6937 people, which is 42.50% of the total number of men who left the country. At the same time, 3361 women of the same age dropped out (32.11% of the total number of women who dropped out).

According to research (International Organization for Migration, 2019), every second young Ukrainian aged 20 to 35 expresses a desire to emigrate from Ukraine, while the age structure of Ukrainian emigrants is divided into five age groups and has the following form: migrants aged 15-19 – 3%, 20-24 years old – 15%, 25-34 years old – 34%, 35-44 years old – 31%, 45 years old and older – 17%. Persons with complete secondary and secondary specialized education make up the largest number of migrants from Ukraine (48%), that is, graduates of secondary schools, gymnasiums, lyceums, colleges, technical schools and colleges; persons with basic higher education account for 24% (graduates of higher educational institutions with educational qualification level “bachelor”), as well as persons with complete higher education - 18% (graduates of higher educational institutions with educational qualification level “specialist” and “master”).

The most important macroeconomic indicator for any country is GDP (Table 3). It forms an idea of the general material well-being of the nation. Ukraine’s GDP is excessively consumer-oriented (growth from 85.6% in 2017 to 93.5% in 2020). A high level of consumption is accompanied by extremely small resources that were saved and could be used for gross capital formation (a decrease from 20.7% in 2017 to 7.5% in 2020). At the same time, per capita GDP is increasing, but the dynamics of positive change is less annually.

Small and medium-sized enterprises, which are able to quickly adapt to changes, have a significant impact on economic and social transformations in the country. But this segment is unstable and during the crisis, their activities are more susceptible to negative changes in the economic and political environment of the country than the activities of big business. In Ukraine, even before the start of quarantine, the conditions for the functioning of small and medium-sized enterprises (SMEs) had many disadvantages. And as a result of the quarantine, about half of the existing SMEs cut from 10 to 30% of the staff.

Table 2

Number of interstate migrants by age group and sex in 2019

	Arrivals			Dropouts			Migration growth, reduction (-)
	both genders	men	women	both genders	men	women	
Total	45011	30777	14234	26789	16324	10465	18222
including age, years							
0–4	1500	778	722	661	341	320	839
5–9	348	170	178	863	451	412	-515
10–14	361	189	172	754	395	359	-393
15–19	10678	6974	3704	1334	881	453	9344
20–24	10326	7355	2971	5670	3925	1745	4656
25–29	5818	4269	1549	4628	3012	1616	1190
30–34	3974	2906	1068	3054	1783	1271	920
35–39	2845	2093	752	2386	1353	1033	459
40–44	2059	1527	532	1878	1141	737	181
45–49	1928	1455	473	1442	928	514	486
50–54	1433	974	459	948	614	334	485
55–59	1369	837	532	827	482	345	542
60–64	940	593	347	755	375	380	185
65–69	611	344	267	549	261	288	62
70–74	356	171	185	431	178	253	-75
75–79	210	80	130	287	97	190	-77
80–84	180	45	135	235	79	156	-55
85 and older	75	17	58	87	28	59	-12

Source: authors' development based on (State Statistics Service of Ukraine, 2020a).

Table 3

Dynamics of Ukraine's GDP

Years	GDP at current prices, mln. USD	GDP per capita at current prices, USD	Final consumer spending		Gross capital formation		Export of goods and services, mln. USD	Import of goods and services, mln. USD
			mln. USD	% GDP	mln. USD	% GDP		
2017	106277,79	2502,32	90943,34	85,6	22051,15	20,7	50957,35	-57674,05
2018	128527,43	3042,26	115455,12	89,8	24124,02	18,8	58107,21	-69158,92
2019	167800,83	3996,46	159803,30	95,2	21135,26	12,6	69087,32	-82225,05
2020	148334,62	353,99	138753,62	93,5	11141,66	7,5	57910,60	-59471,26

Source: constructed by the authors on the basis of the data (State Statistics Service of Ukraine, 2020b).

As a result of the Covid-19 epidemic, the unemployment rate rose from 8.6% to 9.9% (Table 4).

Table 4

Unemployment rate in Ukraine

Years	Economically active population, thousand people	Employed population, thousand people	Unemployed population, thousand people	Unemployment rate, %
2017	17 854,40	16 156,40	1 698,00	9,9
2018	17 939,50	16 360,90	1 578,60	9,1
2019	18 155,70	16 668,00	1 487,70	8,6
2020	17669,80	15995,60	1674,20	9,5

Source: constructed by the authors on the basis of the data (State Statistics Service of Ukraine, 2020c).

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Workers of small and medium-sized businesses suffered the most. According to the State Statistics Service of Ukraine, the number of unemployed has reached 1.6 million people.

In addition to the country's demographic situation, the size of wages in the country has an interstate migration growth (reduction). Since the main reason, for example, for Ukrainian labour migration abroad is a low average wage, which makes about 460 USD per month in the first quarter of 2021 (Table 5). Therefore, migrants move to the European countries in general, as in 14 countries, average wages are over 3 thousand USD. Ignoring the fact that Ukraine's average wage is continually growing, it is still far lower than Ukrainian citizens can make in other countries.

Table 5

Dynamics of average monthly wages in Ukraine

Year, January-December of the corresponding year	Average monthly salary		Real wage index, %	Consumer price index, %
	USD per one full-time employee	in% to the corresponding period of the previous year		
2017	253,11	137,1	119,1	114,4
2018	320,17	124,8	112,5	110,9
2019	443,17	118,4	109,8	107,9
2020	409,94	110,4	107,4	102,7
I quarter 2021	460,28	116,6	108,5	107,4

Source: constructed by the authors on the basis of the data (State Statistics Service of Ukraine, 2020c).

The disappointment with the country's economic situation mainly causes unsatisfactory demographic conditions and people moving to search for work abroad. Thus, Ukrainians went abroad in search of work, devoted their time to self-employment, and had less time to deal with the making and development of their own families, which hit the birth rate, and as a result, lead to Ukraine's low demographic status in general.

However, under Ukraine's negative economic situation, the results of Ukrainian migration abroad in search of work yielded positive results. For instance, for 2011-2018, Ukrainian employees' remittances to Ukraine (Table 6) in USD hit 70369 million (State migration service of Ukraine, 2019).

Table 6

Dynamics of private remittances to Ukraine by countries, mln. USD

Countries \ Years	2015	2016	2017	2018	2019	2020
EU Countries	3397	4254	5697	7150	7728	7596
In % to the total volume	48.8	56.5	61.5	64.4	64.8	63.9
CIS Countries	1992	1553	1515	1250	1397	1159
In % to the total volume	28.6	20.6	15.6	11.3	11.7	9.7

Source: authors' development based on (State migration service of Ukraine, 2020).

Between 2018, 2019 and 2020, there was a significant increase in Ukraine's remittances, hitting a record. We should note that the volume of remittances via informal channels increases annually, indicating mistrust for the country's banking system and employees' attempts to save on additional money on the transfer. The dynamics study of private

remittances to Ukraine by significant countries of origin showed that in 2020 the most substantial remittances were transferred from the EU countries – 63.9%, including 25.7% from Poland, 14/0% less than in 2019. However, in 2020 the migrant workers’ remittances to Ukraine tend to decrease due to about 20% of seasonal migrant workers leaving the country.

Empirical studies of analytical and statistical data (State migration service of Ukraine, 2020; International organization for migration, 2019; NGO “Public Audit”, 2019; State Statistics Service of Ukraine, 2020a,b,c) showed that between all the selected factors affecting the migration processes in the country, specifically the population, there is a correlation dependence of varying degrees in average life expectancy, average monthly wage, GDP per capita and private money remittances to Ukraine (Table 7).

Table 7

Correlation dependence of the leading structural indicators of migration processes in Ukraine

Indicators	Migration growth, reduction	Population	Average life expectancy	Average monthly wage	GDP per capita	Volumes of private money remittances to Ukraine
Migration growth, reduction	1.0000	0.5567	-0.2751	-0.3260	-0.3687	-0.4630
Population	0.5567	1.0000	-0.8375	-0.8009	-0.8369	-0.8923
Life expectancy	-0.2751	-0.8375	1.0000	0.8336	0.8569	0.8590
Mid-monthly wage	-0.3260	-0.8009	0.8336	1.0000	0.9959	0.9722
GDP per capita	-0.3687	-0.8369	0.8569	0.9959	1.0000	0.9883
Volumes of private money remittances to Ukraine	-0.4630	-0.8923	0.8590	0.9722	0.9883	1.0000

Source: author’s calculations.

Such indicators characterize the strongest positive correlation as average monthly wages, GDP per capita, and private remittances to Ukraine. A high positive correlation lies between the average life expectancy, the average monthly wage, GDP per capita, and private remittances to Ukraine. Furthermore, the weakest negative correlation is between migration growth (reduction) and average life expectancy. There are high negative relationships between the general population’s size and average life expectancy, an average monthly wage, GDP per capita, and private remittances to Ukraine. There is an average positive and negative correlation between migration growth (reduction) and the current population size and private remittances to Ukraine. Such indicators as migration growth (reduction) and average monthly wages and GDP per capita have a negatively correlated relationship, indicating a decrease in one variable with an increase in another.

The statistical method of multiple regressions allowed the authors developing a multivariate econometric model of the dependence of migration growth (reduction) ($M_{g(r)}$) on selected indicators, with 0.6173 reliability, and 14979.8995 standard error:

$$M_{g(r)} = -0.0035 \cdot P - 2437.3677 \cdot \bar{E}_l - 33.3650 \cdot \bar{W}_m + 8.8482 \cdot GDP_{1p} - 0.000012 \cdot PTV + 261077.0378, \quad (4)$$

where:

P is population;

\bar{E}_l – average life expectancy;

\bar{W}_m – average monthly wages;

$GDP_{1p.}$ – GDP per capita;

PTV – private remittances to Ukraine.

The developed model is applicable to upgrade the analysis and forecasting of migration processes in Ukraine to ensure a high life quality for current and future generations based on a balanced solution of available and rational use of the state's labour resource potential. The forecast should be dynamic and adaptive to changes, including the latest data, and the proposed model should further be integrated into the existing decision support system for migration processes in Ukraine.

Besides, correlation and regression analysis allow evaluating the current situation by the regression equation. Data on the analyzed factors of volume and movement direction allow obtaining funds for the assessment and appropriate adjustment of the state migration policy.

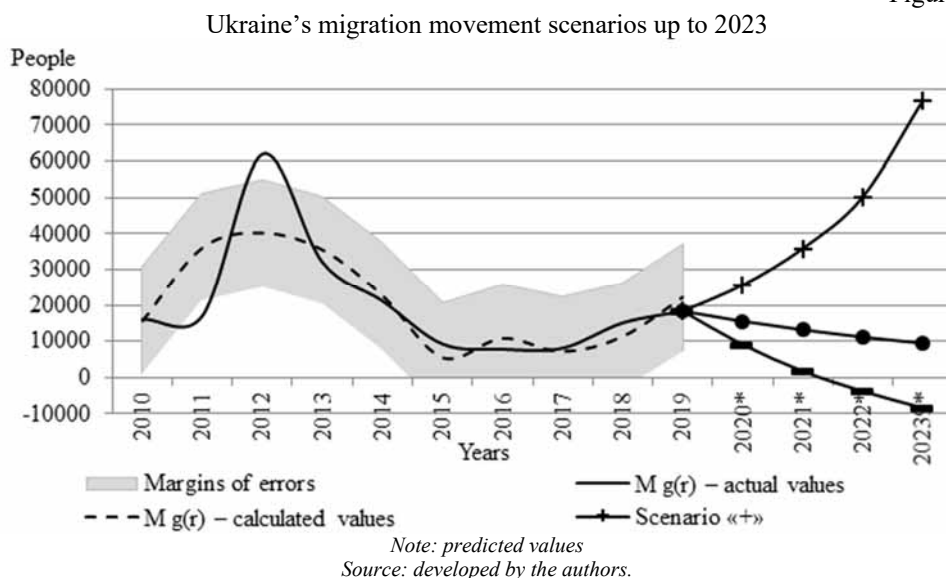
The multifactor econometric model of migration growth (reduction) is placed on the production function. It allows studying the absolute and relative influence of factors on the volume of migration growth (reduction), determining the potential reserves of its increase (decrease), and evaluating them by a comparative analysis. That is, for example, if the volume of private remittances is staggered by 1% (that is, 9424.31 million USD), with other unchanged indicators, there will be a decrease in migrants by 148 people, which is 12.24%.

Thus, correlation and regression analysis provide a powerful and flexible tool for studying the relationship between migration growth (reduction) and many independent variables. Nevertheless, according to the authors, it is essential to carry out forecast computations of the migration growth (reduction) for the future according to three scenarios based on the developed econometric model (Figure 2).

The “+” scenario is that those who come to Ukraine are likely to leave the country (positive migration movement) – which is now Ukraine. That means, if the population continues to decrease over the next five years, it reaches 39522.4 thousand people (another 6% will decrease compared to 2019), the average monthly wage will increase by 27% with the rise of the gross domestic product only by 5.89%, private money remittances to Ukraine by 4%, and the average life expectancy by 1.2% (which is 0.83 years), the migration movement will be “plus” 76.5 thousand people. More than 19% of people are entering the country. Ukraine will experience an increase in unemployment inside the country under such circumstances when financial dependence on family members who have to go abroad for employment and get decent pay; with the growth of social tension; preventing a balance of payments deficit and reducing sufficient demand through remittances; reduced competitiveness of the workforce; growth of tax burdens by increasing deductions from the income of legal migrants; the influx of relatively cheap labour force, with mostly unskilled and therefore lower production costs; with the GDP growth for the maximum involvement of the working-age population; the

development of labour conflicts on political, religious, racial and other issues and, as a result, raising the crime level, and the like.

Figure 2



The “-” scenario is that more people are leaving Ukraine than those entering (negative migration movement). That is, for example, if the population increases within the next five years by at least 1%, with the average monthly wage by 20%, the gross domestic product by 40%, the volume of private remittances to Ukraine by 20%, and the average life expectancy increases by at least half a year, the migration movement will be decreased by 34 thousand people, almost 8% of people leaving the country. Under such circumstances, Ukraine will experience an increase in the country population’s average age and the ageing of the nation, a decrease in working population, and tax revenues. The quality of medical care and the provision of educational services shall decrease. That will harm the quality of the country’s labour potential as a result of the migration of its employees abroad; a decrease in demand for products (goods, services), primarily those business entities that are focused only on the national market, due to decline of the living population; the need to boost spending on social events and the like.

The “0” scenario is that the difference between those who leave and those entering the country tends to zero (the migration movement approaches zero). One can achieve this scenario by comparing some indicators with the minimum indicators of the European Union countries. That is, for instance, with an increase in average life expectancy by 2.36 years (i.e., by 3.3%) over the next five years, an average wage of 3.5 times and a gross domestic product of 5.5 times, a decline in private remittances to Ukraine by 70% and an increase in the population by 50%; the value of the migration movement is approaching zero 1.09 thousand

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people (i.e., 0.2% of the population). There will be a relative balance among all processes related to interstate migration in Ukraine under such circumstances.

Due to the Covid-19 epidemic, mass labour migration has stopped. However, as soon as quarantine is over and regular international transport in Ukraine restores, a new wave of labour migration is expected to be much more potent than that in recent years, primarily due to high unemployment. That is since Ukraine is at the beginning of the economic crisis that will cause a drop in living standards and an increase in unemployment.

According to the authors, the unemployment rate after quarantine may reach 17% of the economically active population (about 3 million people remain unemployed). That is, people will have to go abroad to find employment and return to their own business, located in another country, because the governments of European countries support business and ordinary citizens, including foreigners doing business in their countries, by providing the loans' opportunities at 1-2% per year. Under the circumstances, Ukraine's labour market trends to suffer personnel shortages due to the demographic "pit" of the 1990s, the unstable political and economic situation in the country, and, above all, the migration processes.

Conclusions

Migration processes are a demographic and economical investment for the recipient countries, as they depend on international labour. For donor countries, migration processes cause a decline in the working population and labour and resource potential, as cheap labour and highly skilled employees leave the country. With the quarantine caused by the Covid-19 pandemic, migration has been halted worldwide due to lockdowns, with negative consequences both in recipient countries due to labour shortages and in donor countries with additional financial injections through workers' remittances, affecting the development level of their economies.

As a factor of urbanization and a social phenomenon, an indispensable source of quantitative and qualitative population growth, migration is incredibly essential and requires regulation by the state structures. Otherwise, it transforms into an unmanageable social system that is spontaneously born and developed, leading to negative consequences, undesirable stable parameters and trends, specific content, and a particular orientation. With the quarantine lifting, the regular operation of international transport resuming, leading to a new wave of labour migration, which will be incredibly more potent than that in recent years, due to the beginning of the economic crisis, an increase in the unemployment rate in the country and a decline in living standards. Therefore, the country's job creation factors must be addressed promptly to prevent labour migrants from leaving, as labour is the driving force to fight the crisis.

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IS THE CORPORATE SOLVENCY CONUNDRUM PRIMARILY AN BALKAN ISSUE OR A BROADER EUROPEAN CONTINENTAL MISUNDERSTANDING?⁴

As a consequence of the coronavirus outbreak, the corporate “(in)solvency” issue will probably be one of the most frequently discussed topics in the business and economics fields. We analysed the meaning of the term solvency and the solvency assessment methodology in the papers published in the journals indexed in SSCI from 01.01.2017 to 31.12.2019. We have found that the term “solvency” is inadequately used by the authors from Roman law countries, particularly by those who are from the East European countries. We have also found that the inadequate use of the solvency assessment methodology is conditioned by the scientific field of the researchers. The further the authors are from the legal and accounting fields, the more they are inclined to misuse the term (in)solvent and to introduce the solvency ratio. Finally, we explained the probable origin of this confusion.

*Keywords: solvency; solvency ratio; solvency analysis; firm performance; semantics
JEL: M41; K22*

1. Introduction

As it has been pointed out, “bankruptcy filings have historically tracked broad economic conditions, dropping during prosperous times and rising during recessions” (Wang, 2021; Wang, et al., 2020) Ayotte and Skeel (2020) warn that the prospects for small businesses are bleak and that thousands of consumers and businesses are going to default on their debts in

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the coming months. Therefore, it seems quite clear that the longer-term consequences of this pandemic will arise from mass business failures (Zhang, et al., 2020)

Along with the rise of bankruptcy, the interest of scholar in this topic is also increasing. From an economic and business perspective, the most important issue regarding bankruptcy and failure is the solvency assessment of the companies. Yet, there is a time lag between recessions, bankruptcy and business failures and the publication of scientific papers on this topic.

For example, the exploration of papers published with the subject of bankruptcy in the Web of Science Categories fields Business Finance, Business, Economics, Management, and Law in the period 2000-2007 reveals that 174 papers were published per year on average, but with a clear increasing interest in that topic. In the Year 2006, 231 papers were published, in 2007, when the Global Financial Crisis started with the sub-prime crisis in the US and became global very fast (Shahrokhi, 2011, p. 193), 248 papers were published. In the Year 2008, when the crisis had already gone global, 308 papers were published. During the following crisis years, 374 papers were published in 2009, and 355 papers were published in 2010. The after crisis period brings more interest in bankruptcy subject, 394 papers were published in 2011, 400 papers in 2012, 454 papers in 2013, 491 papers in 2014, 639 papers in 2015, 683 papers in 2016, 702 papers in 2017, 737 papers in 2018, 769 papers in 2019 and 797 papers in 2020. It is therefore evident that there is a lag of several years between the end of a period of crisis and a considerable increase in the number of articles published on the subject of bankruptcy. This could be for several reasons, some of which are based on the specificity of the bankruptcy analysis, while others are based on the time taken to complete the publication process in a scientific journal.

The initial coronavirus outbreak was reported in December 2019 and COVID-19 had been declared a global health emergency (Wu, et al., 2020), while the global pandemic was declared on March 11, 2020. (Ali, 2020), Keeping in mind that the crisis caused by COVID-19 is not even to its end, it could be expected a new wave of scholarly interest in this topic in the following years. The growing interest in bankruptcy is clear when the editorial material of the journals indexed in WoS is looked at. Looking at this criterion, the greatest interest in bankruptcy from the period 2000 to today was in 2009, 2018 and 2020. While 1 editorial material was published in 2010, 12 editorial material was published in the mentioned years. In 2019, 6 editorial material on bankruptcy was published. Given that the COVID crisis is global, it is expected that the discussion about the company's (in)solvency will intensify in the coming years around the globe.

However, there is a widespread misunderstanding about the real meaning of corporate insolvency, i.e. corporate solvency.

Despite the fact that accounting has broadly been seen as the language of business, one of the key accounting terms is used with a different meaning, and it seems that there is no awareness of that. Namely, the term "solvency" is a basic term of corporate law, accounting, and corporate finance. Solvency has been legally defined by various laws, but also by the accounting professional regulation, known as the financial reporting standards.

2. What (In)Solvency Means?

The legal regulations, as well the accounting professional regulations, define the term solvency in a clear and unambiguous way.

But, while the accounting legislation defines what solvency means, the business legislation defines what insolvency means. Furthermore, in the Anglo-Saxon states, the law relating to (in)solvency matters is referred to as “Insolvency Law”.

This is not surprising. While the accounting and auditor profession should assess a company’s solvency in order to realise the fulfilment of the going concern principle, the business legislation should prescribe when insolvency occurs and what insolvency imply.

According to the accounting legislation, solvency is defined as the “availability of cash over the longer term to meet financial commitments as they fall due” (IASC, Conceptual Framework, 1989, par. 16). Every certified public accountant should be familiar with that.

Legal regulations define solvency indirectly by defining its opposite term – insolvency. In legal texts, the term „insolvency“ always means the state of being unable to pay debts as they come due. The consequence of being insolvent is to going into bankruptcy. So, the company is considered as insolvent in the case of (a) illiquidity (the period of illiquidity is different in different countries, and (b) future illiquidity (the assumption is that the illiquidity will occur if the liabilities exceed the value of assets). This is the case at the international level as well. (See: United Nations Commission on International Trade Law, UNCITRAL, Legislative Guide on Insolvency Law, United Nations New York, 2005). Numerous respectable dictionaries define solvency in the same manner (Pavlović, Milačić, 2013).

It is obvious that the accounting legislation and the insolvency laws mean by “solvency” the same but speak from a different point of view. Because “availability of cash over the longer term to meet financial commitments as they fall due” as solvency is defined by IASC (1989), means that the entity will be “unable to pay debts as they come due”, as the legal texts defined the corporate insolvency.

Unlike accounting legislation which does not precisely describe when a company is not considered solvent, insolvency law describes precisely when the insolvency occurred, i.e. the number of days of not meeting debts signifying insolvency.

But neither accounting legislation, nor insolvency legislation describes how to assess a company’s ability to have enough cash over the long term to cover its debts. This task is entrusted to the profession of financial analyst.

The financial analysts assess solvency for various purposes, as: loan approval, investments decisions or trade credit arrangement. Whatever is the purpose, the financial analysts have the goal to assess will the company be able to “pay debts as they come due”, which is possible only if the company has sufficient disposable cash for meeting financial commitments when they fall due.

The accounting regulations prescribe the assessment of solvency in order to ensure compliance with the principle of going concern. But under the going concern principle, the assumption that the entity will continue to exist for the “foreseeable future” effectively means

that the entity will not be required to cease operations or liquidate assets or deposit its balance sheet for the next twelve months (Pavlović, Knežević, 2018). In the Anglo-Saxon literature, that is sometimes called „technical solvency“ which is treated as a special subclass of solvency (Walter, 1957).

While from the insolvency law perspective, as well as from the accounting legislative perspective, the assessment of solvency occurs only when a company is already facing a liquidity problem, or when a company has suffered significant losses, the financial analyst may assess solvency even if there is not yet a sign of insolvency.

Due to the fact that insolvency caused by illiquidity is obvious, that is, it does not need to be assessed, a financial analysis is needed only to assess future illiquidity. The complexity of the contemporary business world makes the solvency analysis more and more complex, and due to the coronavirus outbreak, the financial analysis is becoming more and more complex on a global level.

As Simkovic (2017, p. 310) pointed out, financial analysis play a crucial role in bankruptcy, and “over the course of the 20th century, methods of financial analysis in bankruptcy have shifted from earnings multiples to discounted cashflow (DCF) and recently to market-based approaches such as auctions, market pricing of equity and unsecured debt, and credit spreads.” As Simkovic (2017, p. 300) pointed out, the novel methods of financial analysis have traditionally been developed first by financial economists, mathematicians, professional accountants, risk managers, or investors, but gradually, attorneys and financial experts incorporate the new methods into their legal briefs and expert reports, typically minimising risk by simultaneously presenting analyses using older, more established methods (Simkovic, 2017, p. 300). Scholars have also introduced a large number of business insolvency forecasting models based on various approaches, but each of them has certain limitations that should be understood (Grice, Dugan, 2001).

Anyhow, the solvency analysis must be based basically founded on a firm’s profitability, as well as the firm’s working capital position. The Anglo-Saxon textbook authors in the accounting field do not generally use the term solvency. Instead, they rather use the term “long term liquidity” (Damodoran, 2005; Alexander, Nobes, 2004; Weil, Schipper, 2006). Yet, some, such as Horngren, Sundem and Elliott (2002), use the syntagma “long term solvency“, which is defined as the ability of the organisation to generate enough cash to meet the long term debts when they come due.

The small number of Anglo-Saxon authors who use the term solvency, define it in accordance with the definition of that term in legal texts and professional accounting regulations. As they do not use the term solvency, they neither use the terms “solvency analysis”, “solvency assessment”, or “solvency ratio.”

It does not matter if the syntagma ‘solvency analysis’ is used or not, the solvency in all of the cases is assessed using the indicators of coverage and debt indicator with the purpose of seeing whether the long term debts can be met by cash generated in the normal course of business. In this case, the solvency definition is in line with the indicators used to assess it. It seems logical that a company that is able to cover interest expense with the operational earnings generated in the business and if the same company has lower leverage, as a

consequence it will be exposed to a lower risk of not generating enough cash to pay its debts on time. Although, solvency indicators used in the analysis are not uniform. Many Anglo-Saxon authors measure the ability to pay long term debts using interest coverage ratios and debt ratios. In the context of interest coverage ratio, we find out that two or three different forms exist simultaneously. Some authors (Horngren, et al., 2002; Alehander, Nobes, 2004; Palepu, et al., 2007; Peterson, Fabozzi, 2006) use EBIT/Interest expense formula of this ratio, while others like Damodoran (2005) uses EBIT/ interest expense + principal. In line with this perspective, Higgins (2007) points out that both coverage ratios should be used while Brealy et al. (2003) add an additional coverage ratio in which EBITDA is used in the numerator while interest expense is in the nominator.

Almost all Anglo-Saxon authors use the traditional debt ratios based on financial statement items, while others such as Higgins (2007, p. 396) introduce debt ratios based on the market value of capital and market value of debts.

When small semantic differences have been acknowledged in university textbooks of Anglo-Saxon authors, it seems that there is no end of a diversity of definitions that can be found in the textbooks and papers written by Continental-European authors. Between other, we can find that according to some Continental-European scholars, solvency means “a firm characteristic”, “an indicator of credit capacity”, “a variable for the economic value calculation”, or an “objective of business operation”.

In France and in other countries exposed to French scientific impact, solvency has been often defined as a situation in which the value of the assets exceeds liabilities without taking into consideration whether the company pays its debts or not. This perspective is common to Vernimmen and his associates (2010), who is considered to be one of the most distinguished authors in France. Vernimmen and associates define solvency (*la solvabilité*) as follows: ‘the ability of a company to meet the debts in the event of bankruptcy, and this situation considers termination of a business venture and asset sales’ (Vernimmen, et al., 2010, p. 59). This perspective has been widespread in France in the scientific and academic literature and in the websites from the area of finance and accounting (<http://www.lafinancepourtout.com/>; <http://www.trader-finance.fr>). This perspective is used by many other Continental European authors from less developed countries and the accounting profession (Rodić, 1997; Tepšić, 1988). Hence, the company is considered insolvent only if the total owner’s capital is lost and if liabilities exceed the assets of that company. From this, it can be derived that non-liquid companies can be considered solvent, only if the liquidity value of assets exceeds liabilities.

In the Francophone literature, different approaches to the same subject can be found. For example, in the Mining Faculty in Paris (*l’Ecole des Mines de Paris*), students are taught that solvency (*la solvabilité*) ‘is the ability to meet current commitments if the company needs to terminate the business and its operations immediately’ (*Cours de comptabilité générale*, www.mines-paristech.fr). According to this approach, the solvency concept considers the ability of a company to meet current debts and the following conclusion can be drawn: concepts of liquidity and solvency are almost treated as synonyms in this perspective. Although, the authors state that liquidity is the ability to meet current debts in the normal

course of business, while solvency means: to meet the debts only if current operations are suddenly terminated.

The majority of Continental European authors who have adopted the previous attitude of what solvency means do not in general use coverage ratios at all. Instead, they introduce a “solvency ratio”, which is, in fact, a leverage ratio, or few solvency ratios, but all calculated with the balance sheet items.

3. The Solvency Conundrum

However, outside the legal realm, there has been a huge misunderstanding about the meaning of solvency, particularly about the meaning and purpose of solvency analysis. Namely, even it seems to be quite logical that solvency analysis should be designed to assess the company’s solvency, the logic has been lost somewhere during the centuries of solvency assessment. A strong belief that the future illiquidity will occur is reasonable in the case that a company has lost its capital, i.e. if the company is overdue. This is why the legislators consider a company as insolvent not only if it is not able to meet liabilities that came due (the period of illiquidity is different in different countries), but also if the liabilities exceed the value of the assets, ie if the company is overdue. But, assessing future illiquidity in the case that the company is not overdue, which indicates insolvency as well, is a very difficult task, and this task is entrusted to financial analysts. And from this point, the confusion over the meaning of solvency starts.

Apart from the problem that financial analysts started to define the term solvency from their one role in the solvency assessment, it seems that the problem has particularly derived from the inability to assess a company’s future illiquidity in the past. Namely, when it is known that the term solvency was in use in the 13th century (Pavlović, Milačić, 2013) what is long before that the income statement appeared, it is obvious that solvency could not be assessed using a methodology based on the profitability analysis, which is the ground block of today’s solvency analysis. The appearance of the income statement, which came much later, was not of much help in the time because the results shown in the successive income statements were not comparable for centuries, i.e. until the adoption of the dynamic theory’s postulates. Namely, the comparability of the financial results presented in the successive income statements is a presumption of the profitability analysis.

Due to the impossibility of applying a solvency analysis based on the profitability analysis, the financial analysts at the time could only look at the relationship on assets to liabilities. The same conclusion about the ability to meet liabilities could be brought looking at the relationship on assets to equity, or liabilities to equity. So, these ratios appeared at the time as the only possibility to assess future illiquidity to assess a firm’s solvency. In that manner, the leverage ratio has been proclaimed as the solvency ratio with its different forms. Declaring the leverage ratio as the solvency ratio could be justified at the time also by the fact that when the term solvency appeared, the net worth (owners’ capital) was considered to be a guarantee of paying debts to creditors. Unlike today, at the time when the term solvency appeared, not only the majority of assets presented in the balance sheet could be easily sold, but they could be sold at the values presented in the balance sheet (Pavlović, Milačić, 2013).

Knowing that the legal institute of bankruptcy appeared in the form of personal execution, which means that the debtor was responsible for the fulfilment of obligations, while The Law of the Twelve Tables on which the Roman law has been established, allowed the praetor to condemn the debtor not only as a slave of the creditor until he paid off the debt with his work, but the debtor could also be kept chained and bound and be severely punished (Pavlović, Milačić, 2013), the attitude that solvency means that the assets exceed liabilities could be justified. It is well known that Roman law influenced significantly the EU legal system (Vujović, 2017), and it seems that the solvency conundrum is related to Roman law heritage.

So, as Vernimmen and associates (2010, p. 174) rightly pointed out, the solvency ratio as a measure of the coverage of liabilities by selling assets “represents a legacy of the past and the proof of inertia in finance.” But it seems that the “solvency ratio”, which was established long ago, has led to a misunderstanding of the term solvency itself today. So today, we have a huge confusion, not only on how the solvency of companies should be assessed, but also on what solvency itself means.

It appears that the leverage ratio which has been mistakenly referred to as the “solvency ratio”, which was supposed to help assess solvency, determined the meaning of solvency wrongly assuming that the relation between the assets and liabilities could show the entity’s solvency.

4. Research Questions

In this paper, we will try to answer on four following questions:

- Is the inadequate use of the term “solvency” in scientific papers conditioned by the scientific field of the researchers?
- Is the inadequate use of the solvency assessment methodology in scientific papers conditioned by the scientific field of the researchers?
- Is the term “solvency” in scientific articles primarily inadequately used by authors from Roman law countries?
- Is the solvency assessment methodology in scientific articles primarily inadequately used by authors from Roman law countries?
- Is the term “solvency” in scientific articles primarily inadequately used by authors from former socialist countries of Eastern Europe?
- Is the solvency assessment methodology in scientific articles primarily inadequately used by authors from former socialist countries of Eastern Europe?

5. Data and Methodology of a Research

We analysed the meaning of the term solvency and the solvency assessment in the papers published in the journals with impact factor indexed in the Web of Science (WoS), where solvency is mentioned in the title or paper’s abstract (topic). We explored papers in the

following Web of Science Categories fields: Business Finance, Business, Economics, Management, and Law. We covered the period from 01.01.2017 to 31.12.2019. It should be noticed that some articles are categorised in a few categories, so we gave the total result is different from the sum of the results per category. We did not analyse the use of the term solvency in the article dealing with financial institutions and insurance companies. In these articles, solvency is always used in the meaning of Basel III and Solvency II regulations. We did not analyse the articles dealing with personal solvency, sovereign solvency and fiscal solvency and the articles where solvency is not used in economic-financial meaning as well. If the paper was written by a few authors, if one of them is from Common law countries, we do not consider the article to be written by authors of a country of Roman law, even if one of them is from a country under Roman law, except if the coauthor is not from the field of Law, Business Finance, Business, Economy or Management. The criteria for recognition if the author is from a Common low country or a Roman Law country is the location of the university (organisation) in which the author is employed.

6. Results

6.1. “Law” category

In the WoS category “Law”, five papers mentioned the term (in)solvency, and in all papers, this term was used in bankruptcy and failure context without providing an assessment methodology.

Table 1

Definition and solvency assessment in papers published in the “Law” category

Mentioned in bankruptcy and failure context	5 papers	Ringe, 2018; Fox, 2017; Böckli, et al, 2017; Simkovic, 2017; Park, & Samples, 2017.	Solvency assessment	Used in bankruptcy and failure context	5 papers	Without providing assessment methodology	Ringe, 2018; Fox, 2017; Böckli, et al, 2017; Simkovic, 2017; Park, & Samples, 2017.
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All papers are written by authors from Common law countries (UK and SAD), except one paper written by a few authors, whereby three of them are from Common law countries (UK and SAD). No papers provide a solvency assessment methodology.

6.2. “Business Finance” category

In the WoS category “Business Finance”, four papers mentioned the term (in)solvency.

In the category “Business Finance”, solvency is not mentioned in the context of bankruptcy or failure in just one paper, while in other papers, solvency is mentioned appropriately, or the meaning cannot be reached. The paper where solvency is not mentioned in the context of bankruptcy or failure is written by authors from a Roman law country (Spain). The paper where the meaning of solvency cannot be reached is written by authors from a Common law county (USA).

Table 2

Definition, i.e. the meaning of corporate solvency in papers published in the “Business Finance” category

Definition, i.e. meaning of corporate solvency	2 papers	Mentioned in bankruptcy and failure context	Lamieri, Sangalli, 2019; Mselmi, et al, 2017.
	1 paper	Solvency is not mentioned in the bankruptcy and failure context	Arias, et al., 2017.
	1 paper	The meaning of solvency cannot be reached	Baig, Winters, 2018.

Table 3

Solvency assessment in papers published in the “Business Finance” category

2 papers	Mentioned in bankruptcy and failure context	1 paper	Insolvency prediction models	Lamieri, Sangalli, 2018.
		1 paper	Not specified solvency ratio	Mselmi, et al., 2017.
1 paper	Not mentioned in bankruptcy and failure context	1 paper	Not specified solvency ratio	Arias, et al., 2017.
1 paper	The meaning of solvency cannot be reached	1 paper	Do not provide assessment methodology	Baig, Winters, 2018.

Despite two papers mentioning solvency in the context of bankruptcy or failure, just one paper uses a methodology for assessing solvency in the context of bankruptcy or failure, while the second paper introduces the “solvency ratio” for assessing solvency. So, two papers mention the “solvency ratio” instead of a solvency assessment methodology.

The papers using the solvency ratio are written by authors from Roman law countries (France, Tunisia, and Spain). The paper, which does not provide assessment methodology (where the meaning of solvency cannot be reached), is written by authors from a Common law county (USA), and one paper written by authors from Roman law countries (France and Tunisia) provide a real solvency assessment methodology.

6.3. “Business” category

In the WoS category “Business”, ten papers mentioned the term (in)solvency.

In the category “Business”, solvency is mentioned in the context of bankruptcy or failure in four papers (40%), not mentioned in the context of bankruptcy or failure either in three papers (30%), while in three papers, the meaning cannot be reached.

All the papers where solvency is not mentioned in the context of bankruptcy or failure are written by authors from a Roman law country (Romania, Serbia, and Croatia). Half of the papers, where solvency is mentioned in the context of bankruptcy or failure are written by authors, or with the participation of authors from a Common Law country (USA, UK), while the other half is written by authors from Roman law countries (Spain, Czech Republic, Slovakia, Lithuania) The paper where the meaning of solvency cannot be reached is written by authors from a Common law county (USA), as well as by authors from Roman law country (Spain), or authors from a legal system primarily based on the Roman law (China).

Table 4

Definition, ie meaning of corporate solvency in papers in the “Business” category

4 papers	Mentioned in bankruptcy and failure context		Josefy, et al, 2017; Böckli, et al., 2017; Rodríguez-Rad, et al., 2017; Kljucnikov, et al., 2018.
3 papers	Not mentioned in bankruptcy and failure context	Used in 1 paper as an objective of business operation	Šaponja, et al., 2017.
		Used in 1 paper as a firm characteristic	Vintilă, et al., 2018.
		Used in 1 paper as an indicator of credit capacity	Novokmet, Rogošić, 2017.
3 papers	The meaning of solvency cannot be reached		García-Gallego, Chamorro Mera, 2017; Elmore, 2018; Zhang, et al., 2018.

Table 5

Solvency assessment in papers published in the “Business” category

4 papers	Mentioned in bankruptcy and failure context	Without providing assessment methodology		Josefy, et al., 2017; Böckli, et al., 2017; Kljucnikov, et al., 2018.	
		Insolvency prediction models		Rodríguez-Rad, et al., 2017.	
4 papers	Not mentioned in bankruptcy and failure context	Solvency ratio (based on financial’s statement items)	Capital (equity) to total assets	Novokmet, Rogošić, 2017.	
			Total liabilities to total assets	Zhang, et al., 2018.	
		Solvency ratios (based on balance sheet items)	Total assets/Total equity; Total liabilities/Total assets; current liquidity and Indebtedness		Vintilă, et al., 2018.
			Do not provide ratio		Šaponja, et al., 2017.
2 papers	The meaning of solvency cannot be reached	Do not provide assessment methodology		García-Gallego, Chamorro Mera, 2017; Elmore, 2018.	

All the papers using the solvency ratio or a set of “solvency ratios” based on balance sheet items, which means without including any profitability ratio in the solvency assessment are written by authors from Roman law countries (Romania, Serbia, and Croatia), or authors from a legal system primarily based on the Roman law (China). So no author from a Common Law country has used solvency ratio(s) for assessing solvency, while some authors from a Roman Law country (Spain) have used a methodology design for solvency assessing. Authors from both legal systems did not provide in their papers a solvency assessment methodology.

6.4. “Management” category

In the WoS category “Management”, five papers mentioned the term (in)solvency.

Table 6

Definition, ie meaning of corporate solvency in papers in the “Management” category

Mentioned in bankruptcy and failure context (3 papers)		Mare, et al., 2017; Josefy, et al., 2017; Klepáč, Hampel, 2018.
Not mentioned in bankruptcy and failure context (2 papers)	As an indicator of credit capacity	Novokmet, Rogošić, 2017.
	As variable used for the economic value calculation	Gómez-Navarro, et al., 2018.

All the papers where solvency is not mentioned in the context of bankruptcy or failure are written by authors from a Roman law country (Croatia and Spain&Germany). The authors from Common Law countries (UK, USA) mentioned “solvency” in the context of bankruptcy and failure, as well as some authors from a Roman law country (Czech Republic).

Table 7

Solvency assessment in papers published in the “Management” category

Used in bankruptcy and failure context	Insolvency prediction model (z-score)		Mare, et al., 2017.
	Not explained		Josefy, et al., 2017.
Not mentioned in bankruptcy and failure	Solvency ratio	(Net Income + Depreciation)/ Liabilities	Klepáč, Hampel, 2018.
	Solvency ratio	Capital (equity) to total assets	Novokmet, Rogošić, 2017.
		Not explained	Gómez-Navarro, et al., 2018.

All the papers using the solvency ratio are written by authors from Roman law countries (Czech Republic, Croatia and Spain & Germany). The authors that used solvency in bankruptcy and failure context introduce a solvency ratio based which includes items from the income statement and balance sheet.

All the authors from Common Law countries have used a methodology design for solvency assessing (UK) or did not provide in their papers a solvency assessment methodology (UK & USA).

6.5. “Economy” category

In the WoS category “Economy”, fifteen papers mentioned the term (in)solvency.

All the papers where solvency is not mentioned in the context of bankruptcy or failure are written by authors from a Roman law country (Serbia, Romania, Spain, North Macedonia, and Croatia). The authors from Common Law countries mentioned “solvency” in the context of bankruptcy and failure (USA, UK), as well as some authors from Roman law countries (Croatia, Austria and Czech Republic&Slovakia&Lithuania). One paper written by authors from a Roman law country (Chile) defined solvency “as the ability of a company to cover its long-term obligations”, which is close to the bankruptcy and failure meaning but not totally the same. The papers where the meaning of solvency cannot be reached are written by authors from a Common law county (USA).

Table 8

Definition, ie meaning of corporate solvency in papers in the “Economy” category

Mentioned in bankruptcy and failure context (7 papers)	Šverko Grdić, et al, 2017; Kapeller, et al, 2017; Gorton, 2018; Kljucnikov, et al, 2018; Klepáč, Hampel, 2018; le Van, et al, 2019; Bardoscia, et al, 2019.	
Mention as the ability of a company to cover its long-term obligations (1 paper)	Caldentey, et al, 2019.	
Not mentioned in bankruptcy and failure context (6 papers)	Used as an objective of business operation	Šaponja, et al, 2017.
	Used as a firm characteristic	Vintilă, et al, 2018.
	Proportion of Equity to Total liabilities	Fernández-Guadaño, López-Millán, 2019.
	The share of capital in total assets	Kjosevski, et al, 2019.
	Not specified	Brlčić Valčić, Bagarić, 2017; Dimitrić, et al, 2019.
The meaning of solvency cannot be reached (1 paper)	Frimpong, et al, 2019.	

Table 9

Solvency assessment in papers published in the “Economy” category

Mentioned in bankruptcy and failure context (7 papers)	Without providing assessment methodology (5 papers)			Bardoscia, et al, 2019; le Van, et al, 2019; Gorton, 2018; Kljucnikov, et al, 2018; Kapeller, et al, 2017.
	Insolvency prediction models (1 paper)			Šverko Grdić, et al, 2017
	Solvency ratio (1 paper)	Solvency ratio based on income statement's and balance sheet items	(Net Income + Depreciation)/ Liabilities	Klepáč, Hampel, 2018
Mention as the ability of a company to cover its long-term obligations	Solvency ratios (1 paper)	Solvency ratios based on income statement's and balance sheet items)	Interest coverage ratio; Debt-to-equity ratio; Short-term-debt-to-total-debt ratio	Caldentey, et al, 2019.
Not mentioned in bankruptcy and failure context (6 papers)	Solvency ratio(s) (6 papers)	Solvency ratio based on balance sheet items	Equity to total assets	Dimitrić, et al, 2019; Kjosevski, 2018
			Equity to total liabilities	Fernández-Guadaño, López-Millán, 2019.
		Solvency ratios based on balance sheet items	Total assets/Total equity; Total liabilities/Total assets; current liquidity and Indebtedness	Vintilă, et al, 2018.
		Do not provide ratio		Šaponja, et al, 2017
	Do not provide assessment methodology			Brlčić Valčić, Bagarić, 2017.
The meaning cannot be reached	Do not provide assessment methodology			Frimpong, et al, 2019

All the papers using the solvency ratio(s) are written by authors from Roman law countries (Czech Republic, Chile, Croatia, North Macedonia, Spain, Romania, and Serbia). All the authors from Common Law countries did not provide in their papers a solvency assessment methodology (USA, UK), as some authors from Roman Law countries (Austria, Czech Republic, Slovakia, Lithuania).

6.6. All observed categories

The overall analysis consists of 32 papers. Due to the fact that some articles are categorised in a few categories, the total result is different from the sum of the results per category.

Table 10

Definition, ie meaning of corporate solvency in overall papers

Mentioned in bankruptcy and failure context (17 papers)	Bardoscia, et al, 2019; le Van, et al, 2019; Lamieri, Sangalli, 2019; Ringe, 2018; Kljucnikov, et al, 2018; Gorton, 2018; Klepáč, Hampel, 2018; Josefy, et al, 2017; Böckli, et al, 2017; Rodríguez-Rad, et al, 2017; Mselmi, et al, 2017; Mare, et al, 2017; Šverko Grdić, et al, 2017; Kapeller, et al, 2017; Fox, 2017; Simkovic, 2017; Park, Samples, 2017.		
Mention as the ability of a company to cover its long-term obligations (1 paper)	Caldentey, et al, 2019.		
Not mentioned in bankruptcy and failure context (9 papers)	Used as an objective of business operation	Šaponja, et al, 2017.	
	Used as a firm characteristic	Vintilă, et al, 2018.	
	Used as an indicator of credit capacity	Novokmet, Rogošić, 2017.	
	Used as a variable for the economic value calculation	Gómez-Navarro, et al, 2018.	
	Explained as a proportion of Equity to Total liabilities	Fernández-Guadaño, López-Millán, 2019.	
	Explained as the share of capital in total assets	Kjosevski, et al, 2019.	
The meaning cannot be reached (5 papers)	Arias, et al, 2017; Brlečić Valčić, Bagarić, 2018; Dimitrić, et al, 2019. García-Gallego, Chamorro Mera, 2017; Baig, Winters, 2018; Elmore, 2018; Zhang, et al, 2018; Frimpong, et al, 2019.		

Table 11

Solvency assessment in papers published in overall papers

Mentioned in bankruptcy and failure context (17 papers)	Without providing assessment methodology (11 papers)		Bardoscía, et al, 2019; le Van, et al, 2019; Kljucnikov, et al, 2018; Ringe, 2018; Gorton, 2018; Kapeller, et al, 2017; Josefy, et al, 2017; Böckli, et al, 2017; Fox, 2017; Simkovic, 2017; Park, Samples, 2017.
	Insolvency prediction models (4 papers)		Lamieri, Sangalli, 2019; Rodríguez-Rad, et al, 2017; Mare, et al, 2017; Šverko Grdić, et al, 2017.
	Solvency ratio (2 papers)	(Net Income + Depreciation)/Liabilities	Klepáč, Hampel, 2018.
Mention as the ability of a company to cover its long-term obligations (1 paper)	Solvency ratios	Not specified solvency ratio	Mselmi, et al, 2017.
		Solvency ratios based on balance sheet's items	Interest coverage ratio; Debt-to-equity ratio; Short-term-debt-to-total-debt ratio
			Caldentey, et al, 2019.

Not mentioned in bankruptcy and failure context (10 papers)	Solvency ratio (8 papers)	Solvency ratio (based on balance sheet's items) (5 papers)	Total liabilities to total assets	Zhang, et al, 2018.
			Equity to total assets	Dimitrić, et al, 2019; Kjosevski, 2018; Novokmet, Rogošić, 2017.
			Equity to total liabilities	Fernández-Guadaño, López-Millán, 2019.
	Not explained solvency ratio (3 papers)		Arias, et al., 2017; Šaponja, et al, 2017; Gómez-Navarro, et al., 2018.	
	Solvency ratios (1 paper)	Solvency ratios based on balance sheet's and income statement's items	Total assets/Total equity; Total liabilities/Total assets; current liquidity and Indebtedness	Vintilă, et al, 2018.
Do not provide assessment methodology				Brlečić Valčić, Bagarić, 2017.
The meaning cannot be reached (4 papers)	Do not provide assessment methodology			García-Gallego, Chamorro Mera, 2017; Baig, Winters, 2018; Elmore, 2018; Frimpong, et al, 2019.

Table 12

Definition, ie meaning of corporate solvency in by authors origin

Authors origin		Anglo Saxon authors (USA/UK)	Common-Law countries authors		
			Authors from "Old Europe"	Authors from former communist East-European countries	Authors from Non-European countries
Mentioned in bankruptcy and failure context (17 papers)		10	4	3	-
Mention as the ability of a company to cover its long-term obligations		-	-	-	1
Not mentioned in bankruptcy and failure context (10 papers)	Used as an objective of business operation	-	-	1	-
	Used as a firm characteristic	-	-	1	
	Used as an indicator of credit capacity	-	-	1	-
	Used as a variable for the economic value calculation	-	1	-	-
	Explained as a proportion of Equity to Total liabilities	-	1		-
	Explained as the share of capital in total assets	-	-	1	-
	Not specified	-	1	2	
The meaning of solvency cannot be reached – Do not provide assessment methodology (5 papers)		3	1	-	1

Table 13

Solvency assessment methodology by authors origin

Authors origin		Anglo Saxon authors (USA/UK)	Common Law countries authors		
			Authors from “Old Europe”	Authors from former communist East - European countries	Authors from Non-European countries
Mentioned in bankruptcy and failure context (17 papers)	Without providing assessment methodology (11 papers)	9	1	1	0
	Insolvency prediction models (4 papers)	1	2	1	-
	Solvency ratio (2 papers)	-	1	1	-
Mention as the ability of a company to cover its long-term obligations	Solvency ratios based on balance sheet's items	-	-	-	1
Not mentioned in bankruptcy and failure context (10 papers)	Solvency ratio (based on balance sheet's items) (5 papers)	-	1	3	1
	Solvency ratios based on balance sheet's and income statement's items	-	-	1	-
	Not explained solvency ratio	-	2	1	-
	Do not provide assessment methodology	-	-	1	-
The meaning of solvency cannot be reached - Do not provide assessment methodology (4 papers)		3	-	1	-

Table 14

Using solvency ratio(s) by authors origin

Authors origin	Anglo Saxon authors (USA/UK)	Common-Law countries authors		
		Authors from “Old Europe”	Authors from former communist East - European countries	Authors from Non-European countries
Papers where solvency ratio(s) is mentioned	-	3	8	2
In %	-	23%	62%	15%

7. Discussion

Our research confirms that the term (in)solvency is always appropriately used, i.e. in the bankruptcy and failure context, by authors from the scientific field “Law”. Authors from the scientific field “Business Finance”, who should be familiar with accounting terminology as well with bankruptcy and failure issues, in general, do not use the term (in)solvency and particularly do not use it in an inappropriate manner. Namely, just one paper in this category does not use the term in(solvency) in its legal meaning.

Authors in fields of science that do not necessarily imply a better knowledge of accounting terminology and bankruptcy and failure issues have generally used the term (in)solvency more frequently and have used it contrary to its legal meaning.

Results also show that Anglo-Saxon authors always appropriately used the term (in)solvency, i.e. in the bankruptcy and failure context, while authors from Roman law countries sometimes used it in an inappropriate manner. Among them, authors from former communist East-European countries used it inappropriately more frequently, particularly authors from the Balkan Peninsula, than the authors from Old Europe. This conclusion is particularly reinforced by the fact that authors from former communist East-European countries published, and particularly authors from the Balkan Peninsula, a small part of the total published papers in the observed scientific fields. So we can conclude that in total, very few papers from Roman law Old European countries inappropriately used the term (in)solvency.

Assessing solvency when solvency is seen as an economic variable used for economic value calculation or when solvency is seen just as one of a firm characteristic among other characteristics (productivity, efficiency, profitability, liquidity, etc.) cannot be justified. Scholars who use solvency in that manner obviously used solvency as a synonym for indebtedness. This point of view is quite common in accounting and finance textbooks, particularly among non-Anglo-Saxon authors. The result of this point of view is considering the leverage ratio as the solvency ratio. Considering solvency as a long term business objective cannot be justified as well. The objectives could be to: maximise/improve/enhance shareholders' returns/value; provide sustainable or risk-adjusted returns for shareholders; protect or enhance the interests of shareholders; provide long-term returns for shareholders; provide satisfactory returns for shareholders; and to manage for or in the interests of shareholders. (Ramsay, Sandonato, 2018, p. 108.) In some papers, scholars use the syntagma "long-term solvency". In our sample, in one paper this syntagma was used interchangeably with "financial solvency" and "solvency. (Fernández-Guadaño, López-Millán, 2019). It seems that this opinion of what solvency is a consequence of imprecise modification of the IASB's solvency definition. Namely, the "availability of cash over the longer term to meet financial commitments as they fall due" (IASB, Conceptual Framework 1989, par. 16) implies the availability of cash over the shorter period as well. As it could be seen, in its definition of solvency, the IASB included insolvency caused by illiquidity, because it does not mention long-term liabilities, but "availability of cash over longer term". Reducing solvency just on the ability to meet long-term obligations when they come due open the dilemma of whether illiquidity causes insolvency.

The results show that authors from the scientific field "Law" do not provide a solvency assessment methodology, contrary to the authors from other observed scientific fields. That was quite expected because the insolvency law defines criteria for insolvency but does not provide the methodology for assessing insolvency. Accounting professional regulation does not provide it either. In this domain, financial analysis plays a crucial role (Simkovic, 2017, p. 309).

Results also show that Anglo-Saxon authors did not use an inappropriate solvency assessment methodology. The solvency ratio or a set of solvency ratios based on balance sheet's items, which imply assessing solvency without considering the firm's profitability, is used the most frequently by authors who published papers in the categories of "Business"

and “Management”, and particularly by authors from former communist East-European countries, mainly by authors from the Balkan Peninsula. Namely, six of eight of those papers are written by authors from the Balkan Peninsula. We can also see that some authors from Old Europe appropriately used the term solvency, but included a solvency ratio for solvency assessment, while authors from former communist East-European countries generally defined the term solvency in the term of the solvency ratio that they used. The solvency ratio appears in these papers in various forms, but always shows the same thing.

Not having the possibility to attain the meaning of solvency, which is the case in a huge number of papers, renders the reader incapable of understanding what the scholars meant by using that term. It should be noticed that the semantic content that is given by scholars to the term (in)solvency is not exhausted by the mentioned points of view.

8. Conclusion

Despite, “each shift in bankruptcy court practice followed shifts in financial services industry practice and developments in academic finance” (Simkovic, 2017, p. 309), numerous scholars, including ones from the accounting and finance fields do not consider the term solvency in its legal meaning. Defining solvency differently than the legal text does, lead to the paradox of considering an entity solvent despite the fact that the insolvency court declares this entity insolvent. (Pavlović, Milačić, 2013, p. 463)

Instead of analysing solvency in its legal purpose, numerous scholars analysed solvency in different contexts and for different purposes. Considering solvency differently has, as a consequence, different solvency assessment methodologies. The confusion about what solvency means, i.e. what is the meaning of the solvency analysis spread out on investors, creditors and other stakeholders.

It should be expected that solvency analysis is used to assess solvency. Using solvency assessment methodologies for other purposes than for assessing solvency seems to be quite illogical. So, analysing the performance of a company, that is not considered risky to failure and bankruptcy should not include the solvency analysis. That is the case for most researches of companies’ performance analysis (Zimmer, et al., 2019; Vuković, et al., 2020).

The question which naturally arises from this research is: from where did all this confusion about solvency in scientific papers come from? The answer could be: Because they have uncritically taken the interpretations from textbooks. Namely, all this confusion came from accounting and corporate finance textbooks. The Anglo Saxon authors usually do not use the term solvency, rather they use the term “long term liquidity” (Damodoran, 2005; Alexander, Nobes, 2004; Weil, Schipper, 2006), or use this term descriptively, like the ability to meet the debts or the ability to meet long term debts which is much more common in textbooks. Some Anglo Saxon authors who use the term solvency give a definition of solvency in line with the definition of this term in the legal texts and professional regulation in accounting. The definition mentioned by these authors refers to the “ability to meet the liability when comes due” (Higgins, 2007, p. 396), or “the availability of cash to meet financial commitments as they fall due.” (Weetman, 2006, p. 164). Therefore, solvency assessment

and solvency ratios are almost not mentioned by them. They rather talk about assessing “the ability to meet debts when due” (Higgins, 2007) or about analysis of short and long term liquidity risks (Damodoran, 2005), ratio analysis for the long term creditors (Garrison, Noreen, Brewer, 2006), analysis of long term liquidity risk (Weil, Schipper, 2006), while some authors talk about financial structure analysis (Palepu, Bernar & Peek, 2007) and financial leverage analysis (Peterson, Fabozzi, 2006; Harper, 2002). However, some Anglo Saxon authors mention solvency assessment in their textbooks (Horngren, Sundem, Elliott, 2002, p. 575). On the other hand, solvency is frequently used in textbooks written by Continental European academicians, and the solvency ratio appears in most of the cases.

The question from where all this confusion in textbooks came from would be much more difficult to answer. Pavlović and Milačić (2013) suggest that in the origin of this confusion could be the fact that the term solvency has been used for centuries (it probably appeared for the first time in France, in a document of the city of Reims in 1328, but it was undoubtedly in use before because its meaning is not explained in the document) (Doc. des Archives administratives de la ville de Reims, 1328: 560a; Pavlović, Milačić, 2013, p. 457). At that time, it was not possible to analyse profitability which is the ground block of the solvency analysis. The Income Statement appeared much later, and it took a long time until the financial results from successive Income Statement became comparable, which is the presumption of the profitability analysis. Back in time, when the term solvency appeared, the net worth (owners’ capital) was considered to be a guarantor for paying debts to creditors. It seems quite logical for this period, not just because the Income statement did not exist at that time, but also because the majority of assets shown in the Balance sheet could be easily sold (Pavlović, Milačić, 2013) Consequently, the solvency ratio in the form of debt to assets could be justified. But it seems that the “solvency ratio” established a long time ago led to the misunderstanding of solvency today. It appears that the “solvency ratio”, which was supposed to help to assess solvency, determined the meaning of solvency incorrectly, assuming that the entity is solvent if the assets shown in the Balance sheet exceed liabilities.

The leverage ratio(s) which is(are) often miscalled as solvency ratio(s) is(are) an important indicator(s) of solvency. In the case of declining sales, the company is more likely to become insolvent if the proportion of debt is higher. The banks do not approve credits if the leverage ratio is too high because they are concerned that the company could have a problem to pay it off on time. But that fact does not mean that taking a leverage ratio(s) as a synonym to solvency ratio(s) can be justified. Although it is clear to everyone, that the fact that assets are exceeding liabilities does not necessarily mean that the company will be able to meet liabilities when they come due, the solvency ratio(s) is still very common in the textbooks and scientific papers as well.

According to Pavlović and Milačić (2013), probably due that the bankruptcy regulations in the Anglo-Saxon world are contented in the law named “Insolvency law”, the Anglo Saxon authors usually do not use the term solvency contrarily to its legal meaning. Contrary, in states based on the continental legal system, the bankruptcy law is not named “Insolvency law”. Even more, in some Roman law states, the bankruptcy law often does not even contain the term “solvency” (Pavlović, Milačić, 2013)

So, it seems that the solvency ratio, which was, as explained, for a long time the only instrument for assessing solvency mostly contribute to the solvency corundum today in

Roman Law states in which bankruptcy law is not called “Insolvency law”. This “solvency ratio” has been passed down from generation to generation of scholars and it seems that in some points as the result of not being familiar with its legal sense and why the leverage ratio could be the only way to assess solvency in the past, some scholars started to believe that solvency means just “a firm characteristic”, “an indicator of credit capacity”, “a variable for the economic value calculation” or an “objective of business operation”. But some scholars, such as Vernimmen, Quiry, and Le Fur (2010) or Ranković (1997), are still completely aware of what solvency is, and that considering the leverage ratio as the solvency ratio cannot be justified as the consequence that the leverage ratio is just one indicator of solvency, still used it under this name.

On the other side, all Anglo-Saxon scholars are aware of what solvency means due to the fact that bankruptcy law is called “Insolvency law”.

The resistance to change mindset is a well-known psychological phenomenon, widely explored in the corporate world as well. (Martin, 2017; Dent, Goldberg, 1999). This study reinforces the findings of Oriji and Amadi (2016) which claim that changing mindsets is needed between resistant scholars as well. Scholars should embrace a critical approach to literature.

As a consequence of not reviewing the acquired knowledge, there are many illogical occurrences in the textbooks and legislative which are primarily a consequence of the penetration of the Anglo-Saxon theory and practice in a region otherwise based on Continental European practice. For example, the parliament of Montenegro in late 2002 brought a new law for bankruptcy issue, which under the influence of Anglo-Saxon law had been called “*Company Insolvency Law*” (Zakon o insolventnosti privrednih društava, “Sl. list RCG”, No. 06/02, 01/06 and 02/07) and introduced in that way the term “insolvency” in the title of the law aims to regulate the bankruptcy issues. But in this law, the term insolvency was not even defined. Paradoxically, in the first article of this law which regulates the conditions and procedure of the event of insolvency, the term insolvency was not even mentioned. In January 2011, Montenegro passed a new law (Zakon o stečaju, “Službeni list Crne Gore”, No. 1/2011 and 053/16) in which the term “solvency” was avoiding non just in the title of the Law, but as well in the entire legal text.

It’s even more paradoxical that in some countries in which laws regulate bankruptcy, the insolvency term is used neither in the legal text nor in the title of the law, but on the other hand, the term solvency has been used in other laws that do not treat bankruptcy issues. In those laws, solvency is treated in the same way as it was treated by Anglo-Saxon law and international regulation. This is the case of Serbia and Croatia. Croatia has been an EU member state, while Serbia is an EU candidate country. It seems that confusion spreads around the EU arena.

The situation is quite similar to some other accounting terms where not only academics but also regulators resist using the terms correctly (Pavlović, et al., 2018).

The problem of giving inadequate semantic content to the term “solvency” contributes to the confusion about this term in some laws as well, which deepens this problem further (Pavlović, Knežević, Milačić, 2016). On the contrary to the previous one, in the new The Conceptual

Framework for Financial Reporting of IASB (2018), the term “solvency” is not defined, probably because the IASB members thought that the meaning of this term is clear. Our findings suggest that this term should be defined. Namely, it is obvious that “assessing solvency” could be interpreted differently.

As the result of the solvency conundrum, some scholars, who are aware of the different meanings are given to this term today, believed that corporate solvency has different meanings.

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EVALUATING THE IMPACTS OF PASSENGERS' RIGHTS POLICY ON THE COMPETITIVENESS OF AIRLINES AND AIRPORT OPERATORS USING THE DYNAMIC PROGRAMMING APPROACH³

The passengers' rights protection policy is crucial for providing the quality of air transport services and has a significant impact on the competitiveness of airlines and airport operators. This impact can be measured by defining a system of quantitative and qualitative indicators and can be managed by adopting adequate efficiency-enhancing measures of this policy that contribute to the greater competitiveness of all the players in the European air transport market. The study aims to present the opportunities of a dynamic programming approach to enhance the efficiency of passenger rights' protection policy in terms of the competitiveness of airlines and airport operators. The application of the model has been empirically tested and, on this basis, a proposal to update the passengers' rights protection policy has been worked out by the authors and the expected impacts and effects of its implementation have been examined.

*Keywords: air transport; passenger rights policy; dynamic programming
JEL: R41; R48*

1. Introduction

The globalization imposed increasing mobility of people and goods, as well as a growth of air transport activity worldwide in recent years, and it led to an increase in the demand and supply of passenger transport and the need to create more efficient processes for servicing the air passengers and their luggage (Nanfosso, Hadjitchoneva, 2021). These processes are an important part of the concept for improving the quality of air transport services. A strong competitive environment in air transport leads to an expansion of market opportunities for carriers. Airlines aim to diversify their operations to reduce costs and increase the quality of their services. In addition, the emergence of low-cost carriers on the European market leads

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to further stimulating competition in the air sector and contributes to an increase in the efficiency of airports in operating flights (Curry, Gao, 2012). This, on the other hand, requires the development of new measures of the European air passengers' rights protection policy. Its aim is to achieve effective and harmonized implementation with appropriate instruments (mechanisms) to create a uniform and clear interpretation of the EU laws. This will ensure equal conditions for all air transport operators and will support building European standards for the protection of citizens (European Commission, 2011).

At this stage in studying the influence of air passengers' rights protection policy, there are gaps and uncertainties that hamper its effectiveness and impede the assessment of its impacts on the competitiveness of airlines and airport operators. Airlines are taking advantage of the current situation to justify their delays as 'extraordinary circumstances' and thus not to pay compensation to passengers. It is, therefore, necessary to identify appropriate measures to increase the effectiveness of the policy. These measures must be aimed at clarifying the concept of 'extraordinary circumstance' – strictly determining which cases are identified as such and which are not; setting up a compensation fund for long delays; providing rules for the establishment of representatives (including authorized) of airlines at each airport, for decision-making in case of delays; reviewing the compensations' sizes; sharing the burden of compensations with third parties, etc.

Obviously, the air passengers' rights protection policy needs a revision and there is a need to improve its efficiency in order to achieve better air services' quality and airline performance, especially in the current situation. Something more, a research gap exists with regards to the assessment of the impacts of passengers' rights protection policy on airlines and airport operators' competitiveness, that could be filled by suggesting an appropriate approach for assessing these impacts.

The main goal of this study, with regards to the assessment of the impacts of passengers' rights protection policy on the European level, is to apply an economic analysis method for the examination of quality indicators and measures applied and their influence on the competitiveness of airlines and airport operators. An important condition for increasing competitiveness is the implementation of an adequate and successful pricing policy, which is built based on an in-depth study of the aviation sector (Wehner, et al., 2018). For airlines to successfully compete with other air carriers offering lower prices, it is necessary to monitor trends of change in the demand-supply ratio of air transport (Costa, et al., 2019). The analysis will reveal opportunities to increase the quality of services, as well, which is a prerequisite for attracting more passengers and increasing the competitiveness of airlines and airport operators (Mutafchiev, 1997).

2. Quality of Services and Competitiveness in Air Transport as a Concept

The competitiveness as a term refers to the ability to surpass competitors under conditions of free competition (Bao, Xie, 2002). Bao and Xie define the competitiveness of airlines and airport services as "the ability to provide high air passenger services' quality at reasonable prices by ensuring passengers' right protection when compared with other competing airlines and airports under certain traffic conditions". With regards to this, the authors of the current

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study argue that passengers' rights protection policy has a potential to provide improvements in the quality of passenger transport by air and, accordingly, to enhance the competitiveness of air carriers and airport operators. Therefore, in order to assess the impacts of passengers' rights policy on the competitiveness of airlines and airport operators, it is necessary to define a system of air transport services' quality indicators and determinants which reflect both airlines and airports' services. The relationship between the passengers' rights policy and the competitiveness of airlines and airport operators, as examined in this article, is modelled according to the European model for impact assessment of passengers' rights policy, adapted in line with the objectives set out in the study.

The competitiveness of an airline is determined by two main groups of indicators: pricing policy and levels, and the quality of services offered. The main economic prerequisites for increasing the competitiveness of air carriers are the reduction of the costs of carrying out the transport activities and the improvement of the quality of transport services. By reducing costs, airlines could offer competitive transport prices. Improving quality- in turn – provides an opportunity to attract more passengers, leading to an increase in flight intensity, and thus making for higher revenues for airlines (Bakalova, Nikolova, 2010, p. 175).

The achievement of high quality of the services offered is characterized by a system of indicators, which are an integral part of the air transport process. These indicators include Security, Safety, Regularity, Accuracy, Flights' intensity, Flights' duration, Convenience and Culture of service (see Table 1).

Table 1

Indicators and determinants of air transport quality

Indicators	Measures
Security	development and modernization of aircraft and aerodrome facilities to ensure unhindered travel
Safety	necessity of continuous improvement of the operation of aircraft; improving the qualification of staff; organizational factors of the movement to ensure safe flights
Regularity	frequency of the proposed flights, overcoming adverse weather conditions
Accuracy	take-off and landing of aircraft in accordance with the announced timetable; depends on the workload of air traffic; ensuring the roadworthiness of aeroplanes
Flights' intensity	number of flights offered (how many times a week flights to a destination are made)
Flights' duration	reducing travel time; possibility of catching up on flight delay
Comfort	comfort and additional services provided on board – depending on the type of aircraft; location of seats and travel class
Culture of service	meeting the needs of different types of services during the journey and courtesy of cabin staff; pre-flight control and handling of passengers and their baggage

Source: Suggested by the authors based on SERVQUAL scale (Jain & Gupta, 2004) and adapted according to Mutafchiev (1995)

All of the indicators should be incorporated into the assessment model in order to reveal to what extent they correspond and influence the passengers' rights protection policy. Based on this, and on the other hand, recognizing the quality of services as a strategic tool for attaining operational efficiency and improved business performance, i.e. business competitiveness, the

authors use the SERVQUAL approach suggested by Jain and Gupta (2004) in their article ‘Measuring Service Quality: Servqual vs Servperf Scales’. According to them, it is not easy to identify and measure the service quality due to inherent characteristics of services that make them different from goods. SERVQUAL and SERVPERF are presented as major service quality measurement scales. With regards to the explanatory power of the models, Jain and Gupta provided evidence that the SERVPERF scale provides a more convergent and discriminant-valid explanation of service quality construct. However, the scale is found deficient in its diagnostic power. They provided evidence that it is the SERVQUAL scale that outperforms the SERVPERF scale by ensuring higher diagnostic power to define areas for managerial and policy interventions in the event of service quality shortfalls (Jain & Gupta, 2004).

These findings are further supported by the study of Carvalho and Medeiros (2021), making a comparative analysis of two evaluation models (SERVQUAL and SERVPERF) to investigate the factors that influence the quality of airline services, using statistical techniques such as Cluster Analysis and Structural Equation Modeling (SEM). They found out that the SERVQUAL and cluster analysis allow airline managers to identify and prioritize gaps in service delivery according to criticality, aiming at the allocation of efficient resources by the airline. The SERVPERF and SEM provide statistical evidence of the impact of different dimensions of service quality on customer satisfaction, highlighting the direct relationship between satisfaction and different quality indicators. Considering how customers evaluate the service provided by airlines, particularly regarding the service they receive from airport employees, this study has relevance for decisions taken by airline managers to develop quality services and provide guidelines for improvements in airline services (Carvalho, Medeiros, 2021).

Bellizzi et al. (2018), in their study “Air Transport Passengers’ Satisfaction: An Ordered Logit Model”, argue that the airline industry has a vital role in countries’ development and competitiveness. They pay attention to the fact that airport facilities and services are the first experiences that passengers receive upon arrival at the airports. The authors propose a tool for measuring airport service quality starting from the passengers’ reviews about services by using the Ordered Logit Model for evaluating the influence of different service factors on service quality, by considering passengers’ satisfaction with the service factors and the overall service (Bellizzi et al., 2018).

Another important issue to be considered when assessing the quality of air passenger services is to reveal whether there exists a distinction between the service quality of full-service and low-cost operators. Lim & Lee (2020), in their study called “Comparisons of service quality perceptions between full-service carriers and low-cost carriers in airline travel”, quantitatively determine the dimensions of service quality parameters that are deemed as most essential by travellers. The authors apply Latent Dirichlet Allocation Topic Modeling to a vast number of online reviews for airline services to compare service quality between full-service carriers (FSCs) and low-cost carriers (LCCs). The results of their study show that the most significant dimensions for FSCs and LCCs are tangibles and reliability. The least significant dimensions revealed by the study are assurance and empathy, respectively. By comparing extracted dimensions in detail, Lim & Lee discover specific differences in traveller perceptions between FSCs and LCCs (Lim, Lee, 2020). However, in terms of air

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passengers' rights protection policy on the European level, there are not any specific provisions for low-cost operators compared to full-service carriers that make a difference in the treatment of the quality of services in question.

Additionally, Curry and Gao (2012) have proved that though both the service quality and customer satisfaction have a positive influence on repurchase intentions, customer satisfaction is a much stronger driver in influencing repurchase loyalty than service quality, which implies that these constructs interact in a different manner in a low-cost setting. This finding is of crucial importance with regards to airlines and airports' competitiveness and it provides a clear relation between the level of quality of air passengers' services and pricing models and levels applied by the airlines and airports.

With regards to the eventual differences in the level of competitiveness of FSCs and LCCs, Alamdari and Fagan (2005) found out that although an increasing number of 'hybrid' low-cost models are achieving low operating costs compared to FSCs, offering low fares, and returning attractive operating profit margins, there is a case for recommending adherence to the original model to ensure greater profitability. They suggest a study providing evidence that the low-cost carriers tended to follow a differentiation strategy as opposed to cost leadership on which the original low-cost model was based (Alamdari, Fagan, 2005). However, this does not change the initial point and the equal basis for treating the same way LCCs and FSCs when applying the air passengers' rights protection policy.

Another piece of research dedicated to the interrelation between air services' quality and prices investigates how perceived price, airline service quality, perceived value, passenger satisfaction and airline image determine passengers' future behavioural intentions (Park, Robertson, Wu, 2006). The authors found that there were significant relationships between air services quality and prices. Perceived price, perceived value, passenger satisfaction, and airline image were each found to have a direct effect on passengers' future behavioural intentions. Thus, Park, Robertson, and Wu (2006) provide a solid ground for further research through extended modelling of impacts of the air passengers' protection policy on the service quality and pricing policy being the main aspects of the competitiveness of airlines and airports.

Similarly, Martin, Roman and Espino (2008), in their article called "Willingness to Pay for Airline Service Quality", provide empirical monetary valuations of air travel regarding level-of-service attributes. They examine the variations in values, according to different characteristics of the services, such as price, penalties for changes in the ticket, legroom, food, etc.; the currently experienced level of the service quality, and various socio-economic factors that affect the characteristics of the air trip and passengers. Thus, they provide a prerequisite for evaluating the willingness-to-pay for different improvements of service quality (Martin, Roman, Espino, 2008). All these studies suggest important arguments for incorporating passengers' rights policy into the wide service quality framework and evaluating its efficiency potential to contribute to higher airlines and airports' competitiveness.

An important study, providing ground for identifying the role of relational benefits between service quality, the level of satisfaction and loyalty of passengers is authored by Chen and Hu (2013). The authors have performed a personal survey of air passengers and found that

service quality has positive impacts on relational benefit and customer loyalty in the airline industry. They argue that service quality, basically, seeks to measure the company's performance along transactional dimensions, whereas relational benefits measure the intangible aspects of relationships between the airlines and their clients, related to the core elements of the service (Chen, Hu, 2013).

Dálfonso and Nastasi (2014), in their study called "Airport-Airline interaction: some food for thought", provide additional arguments for pointing out our scientific research interest not only to the air carriers' service quality but to airports' operators, as well. They provide an interpretive analysis of vertical relations between airports and carriers, while assessing the way in which deregulation of the airline market and the privatization of airports have created incentives for the airport-airline interactions in providing air passenger transport services (Dálfonso, Nastasi, 2014).

Finally, in order to broaden the focus of the study and to take into account the impact of the COVID-19 pandemic on the air transport sector and passengers' rights protection, account should be taken of the specificities of the change in demand for air transport over the last 2 years. Gallego and Font (2021), in their study "Changes in air passenger demand as a result of the COVID-19 crisis: using Big Data to inform tourism policy", provided evidence that for travel during the May to September 2020 period, the desire to travel (based on the number of flight searches) has dropped by about 30% in Europe and the Americas, and by about 50% in Asia, while the intention to travel (the number of flight picks, the final selections amongst flight searches) has dropped a further 10-20%. Most source markets remain optimistic about air travel during the whole 2021, suggesting a U shape recovery. However, the recent developments in air transport show a rather flatline L shape of recovery (Gallego & Font, 2021). Something more, the UK consultancy SKYTRAX, running an airline and airport review and ranking site, provide up to date COVID-19 Airlines and Airports' Safety Rating as a trusted assessment and certification of airline and airport's hygiene and safety measures during the coronavirus pandemic, based on detailed and professional investigation of the standards being provided by the airlines at the airports and onboard flights. It is the world's first COVID-19 Safety Accreditation for the airline industry, regarded as a global benchmark for defining safe travel assurance for customers by complex analysis of the hygiene improvement procedures and systems introduced by airlines during the coronavirus pandemic. SKYTRAX do rate an airline's front-line staff adherence to safety standards, based on direct audit experience and analysis of how efficiently and consistently airport and cabin safety standards are applied by an airline's staff, before and during flights, thus providing the air passengers' rights during their travel. The Ratings are based on the effectiveness and consistency of each airline's and airport's COVID-19 cleanliness, health, hygiene, and safety protocols, and do not evaluate any temporary service changes due to COVID-19 (e.g., closed lounges, cuts in onboard catering etc.) (Skytrax, 2021). The site doesn't publish comparative ratings of airlines and airports' safety records because there is no single accurate, global reference of safety standards and/or safety incidents that provides information that can be truly trusted by passengers, or which supplies total accuracy to customers in choosing an airline.

On the other hand, recent studies related to the developments in passengers' rights protection policy during the COVID-19 pandemic show that air passengers were not informed fully

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about their rights during the COVID-19 pandemic (European Court of Auditors, 2021). The study provides information and statistics showing that in the initial period of the crisis, many passengers were not reimbursed, or had no other choice than to accept vouchers. The authors recommend that the Commission should better protect the rights of air passengers and inform them about their rights; enhance the coordination of national measures and better link State aid to airlines to the reimbursement of passengers; and improve the tools and legislation for safeguarding air passenger rights.

3. Approaches to Examining the Interrelations Between Passengers' Rights Protection Procedures and the Competitiveness of Airlines and Airport Operators

In order to examine the interrelations between procedures for the protection of passengers' rights and the competitiveness of airlines and airports, as well as to assess the impact of the policy adopted in this field at the European level, the dynamic programming method may be applied (Bellman, Dreyfus, 2015). The need to evaluate the interrelations between the passengers' rights protection procedures and the competitiveness of airlines and airports impose some specific computational requirements that render infeasible the exact solution of the problems related to this policy. The authors of this study suggest their view on the application of an efficient economic method based on dynamic programming for approximating solutions to enhance the efficiency of air passengers' rights policy and provide positive results on airlines and airport operators' competitiveness. The approach "fits" a linear combination of pre-selected basic functions to the dynamic programming approach (Farias, Van Roy, 2003). With regards to this, it is suitable for developing multi-stage decisions on tasks related to air transport management, as suggested by Mutafchiev and Vasilev (1999). The tasks related to the definition of measures to protect passengers' rights, as a part of the policy to increase the competitiveness of carriers and airport operators, are also multi-stage. The consistent development of different variants for upgrading measures and procedures to protect passengers' rights, considering air transport quality and competitiveness parameters, is a variety of dynamic programming. In the step-by-step resolution of this task, results can be obtained on the expected effects and impacts of the implementation of the relevant measures to protect passengers' rights and their impact on the quality of air services and the competitiveness of airlines and airports (Mutafchiev, 2003). The ultimate objective of this approach is to prioritize those measures that have the most significant positive impact and to suggest them for inclusion in the Strategy for the protection of air passengers' rights.

Dynamic programming (optimization) is based on the principle of optimality formulated by Richard Bellman in 1962 as follows: "a policy is optimal if, for a given stage, regardless of what the decisions of the previous stages were, the decisions to be taken draw up an optimal policy, considering the results of the previous stages" (Bellman, 2007). Applying this principle to solving the specific task can be defined as follows: "optimal policy (strategy) contains only optimal sub-policies". Very often, when solving economic tasks of strategic importance, it is necessary not to make an independent decision at a particular time, but a number of interconnected and consistently implemented decisions on the management of a

system, such as air quality indicators following the logic of the application of dynamic programming as suggested by Cvitanić, J., Possamaï, D. & Touzi, N. (2018).

The principles of dynamic programming can also be applied in solving tasks that are not multi-stage but depend on the logic of the decision process itself (Belmann & Dreyfus, 2015). If available measures are given (number) V , which must be distributed in the most economically advantageous way between the i processes ($i = 1, 2, \dots, n$) for quality improvement, it can be assumed that the use of part of these measures b for each process is characterized by an expected effect $w_i = f_i(b_i)$, which means that the *resulting effect is a function of the measures taken*. In cases where the function is of an unclear kind, as it is in the case of the appropriate measure of air passengers' rights protection policy, it is necessary to apply the principles of dynamic programming.

The aim is to explore, through dynamic programming, options to optimize the policy to protect passengers' rights by breaking them into separate elements. The elements of the dynamic programming model will be introduced using an example that solves the following task of minimizing the cost of compensations provided by the airlines. Solving this task will lead to appropriate solutions for providing greater efficiency of air transport services and increased competitiveness of airlines and airport operators.

Assuming that some of the measures under the heading function are

$$w_{i_k} = \sum_{i=1}^k b_i \quad (1)$$

then $F_k(Z_k)$ is the function that characterizes the maximum effect of that distribution in different meanings of the Z_k . When including in the solution the task of another process ($k+1$), the function that characterizes the maximum effect of its distribution in different Z_{k+1} acquires the following type:

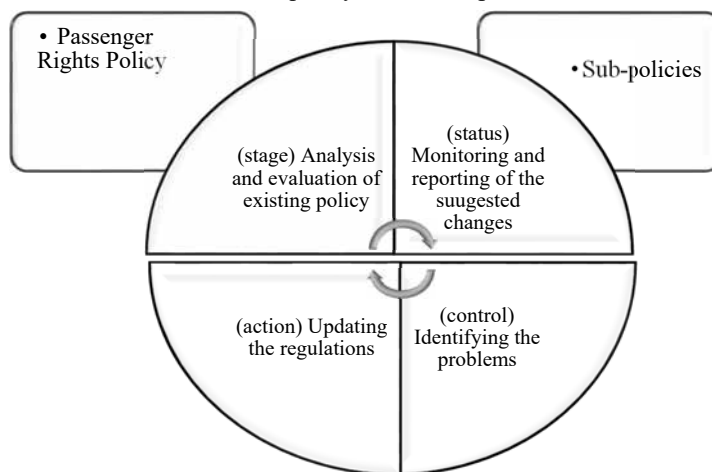
$$F_k + (z_{k+1}) = \max[f_{k+1}(b_{k+1}) + F_k(Z_k)], \text{ where } Z_k + b_{k+1} = Z_{k+1} \leq V. \quad (2)$$

This function defines part of the measures for each $Z_{(k+1)}$ (for variants $k+1$), result for all $k+1$ variants as suggested by Mutafchiev & Vasilev (1999). The implementation of the principle of dynamic programming in the resolution of tasks is aimed at determining the optimal sequence of the introduction of new measures to protect passenger rights. The maximum efficiency (F) of transport services in terms of measures to protect the rights of air passengers can be expressed as follows:

$$F = \max \left[V \left(\frac{c \cdot x}{10} \right) \right] \quad (3)$$

Through dynamic programming methods, passengers' rights protection policy is decomposed into separate processes in four steps, which are repeated if policy changes are required when not sufficiently effective. The steps are elaborated based on William Deming's method of cyclicity of processes (2018), which are decomposed into four main steps: PDCA (Plan-Do-Check-Act). The first step sets out the problems and analyses the current regulations. The next step is to monitor and document the proposed amendments. The third step considers the identification of problems, and the latter is an update of the current regulations (Figure 1).

Figure 1
Decomposition of the separate stages in defining the passenger rights policy considering the quality of air transport



Source: Adapted from the Deming cycle for continuous quality improvement.

The dynamic programming approach includes the following elements: stage, condition, variants, target function and recurrent ratio (functional equation). The stage is a part of the task, which has its own alternatives, among which the best is to be found. With regards to the achievement of the objectives of the study, the current regulations related to air passengers' rights protection have been analyzed and their condition assessed. The proposed variants by the EU to change the current regulations have been analyzed based on the maximum values of the coefficients as a target function of the $f_j(x_j)$. The measures with the highest values are included in a new version. For the decision based on the dynamic programming method, all options considered shall look for the one with optimal value, simultaneously providing maximum coefficients and minimum costs.

As a result of the review of the policy on the protection of passengers' rights in air transport and the regulations in force in the EU, certain shortcomings and omissions may be identified therein. All identified problem areas are involved in the development and proposing of new measures to protect passenger rights in the following sections of the article and their impact on the quality and competitiveness of air carriers and airport operators are examined using the dynamic programming approach to solve multi-stage tasks.

4. Defining a System of Measures to Protect Passenger Rights and to Improve the Quality of Air Transport

The European Commission has analyzed the passengers' rights policy applied so far and suggested 4 options (variants) for changing the policy with a view to improving the exercise

and enforcement of air passengers' rights (European Commission, 2017). With regards to this analysis, as well as on the basis of a defined and analyzed system of indicators and determinants of air services quality, the impact of the passengers' rights protection policy on the competitiveness of airlines and airport operators can be assessed.

In order to increase the effectiveness of enforcement policy between December 2011 and March 2012, public consultations have been held and stakeholders have expressed their views on the outcome of these consultations (Steer Davies Gleave, 2012). The Commission has assessed four policy options with a view to improving the exercise and enforcement of air passengers' rights (European Commission, 2014). These are as follows:

Variant 1 focuses on the economic incentives to reduce costs by replacing some of the care obligations (food, hotel accommodation) by airlines.

Variant 2 focuses on balancing policy for stricter implementation with economic instruments. It envisages measures for better coordination of national enforcement authorities in providing information to the Commission on their activities. The Commission, for its part, will have the right to request investigations in circumstances that infringe passengers' rights, especially in cases where airlines from the several Member States are involved. The costs of airlines' obligations to provide care and assistance to passengers will be offset by a reduction in the frequency of the payment of compensations under two sub-options:

- *Variant 2a* provides for an increase in the compensation time threshold from 3 hours to 5 hours after the passenger is entitled to compensation for the inconvenience caused by the flight delay.
- *Variant 2b* provides for the extension of the scope of 'exceptional circumstances' to include technical failures of the aircraft identified and immediately prior to flight.

Variant 3 focuses on stricter enforcement of existing passenger rights without making changes to regulations.

Variant 4 focuses on a fully centralized implementation policy to counter negative incentives arising from compliance costs by setting up a central EU law enforcement body.

The review of the proposed variants and the current regulations gives an opportunity strengths and weaknesses of the policy to be identified and a solution to the problems identified to be proposed by applying the dynamic programming method. The problem areas are identified based on the weaknesses identified in the current study and an alternative option is proposed aimed at improving passengers' rights protection policy and helping to increase the competitiveness of airlines and airports.

In the following sections, by using the dynamic programming approach, the authors propose a new option (variant) to improve the policy on the protection of air passengers' rights, based on the 4 options proposed by the Commission and aimed at helping to improve the quality of the services offered. The results of the implementation of this approach demonstrate the capabilities of the passengers' rights protection policy instruments to provide an increase in the competitiveness of airlines and airport operators.

Table 2

SWOT analysis of the of the air transport regarding passengers' rights policy

Strengths	Weaknesses
<ul style="list-style-type: none"> • fully harmonized application of the Regulations in EU countries; • increase in long-distance passenger service (business and/or personal travel) due to globalization. The global trend shows an increase in the number of aircraft, an increase in the capacity, as well as an increase in the number of destinations to which different airlines travel; • over the past 20 years, the substantial increase in demand for air transport, both in the EU and globally, has led to a significant development of the European aviation sector. Air transport users benefit from an unprecedented choice of travel options at competitive prices. The number and frequency of domestic flights in the EU and on international routes, as well as the number of passengers, have increased significantly. Low-cost EU carriers are now among the leading carriers, both in terms of passenger carried and market capitalization; • the creation of the single aviation market removes existing restrictions on air transport rights for airlines registered within the EU. Air carriers can operate flights to any destination in Europe without restrictions. 	<ul style="list-style-type: none"> • financial collateral – need to set up a guarantee fund to provide and guarantee compensation payments by airlines; • incomplete formulations – there is a need for precisely defined situations that fall into the category of ‘exceptional circumstances’ in such a way as not to infringe passengers’ rights but at the same time to be relevant to airlines; • formal role of national law enforcement authorities – at this stage, national enforcement authorities, as supervising the implementation of the regulations, act as ‘mailboxes’ for forwarding complaints to the European Consumer Centre. National enforcement authorities in the EU countries can also be used as arbitrators in cases to identify or reject situations and events categorized as ‘exceptional circumstances’; • absence of a single registration system – registration systems are distinguished by individual airlines and airports, and the establishment of a single passenger registration system to be used by all airlines will help to exchange passenger data more quickly and easily between EU airports, both to protect their rights and to increase the security of air transport; • adjustments to the right of re-routing – it is necessary to provide for passengers to be entitled to re-routing, even for delays of less than 4 hours; • lack or failure to provide data from airports – regulated assistance from airports is required by providing video recordings in cases where the passenger has arrived later than the specified boarding time and has therefore been denied boarding; • slow and complicated procedures – need to change the procedure for submitting and handling complaints – to facilitate the use of passengers; • It is necessary to refine the liability of carriers – reduce carriers’ liability for minor damage to checked baggage (scratches etc.).
Opportunities	Threats
<ul style="list-style-type: none"> • improving the quality of air transport – by updating the legal framework, specifying concepts at the EU level, engaging national law enforcement authorities, facilitating procedures in cases of complaints; timely information exchange of data between airlines, airports, and service operators; • the competitiveness of airlines will increase, therefore, the prices for air transport services will be more affordable and will help to increase the demand for air transport; • increasing demand for passenger air transport will help to create new jobs for ground operators, which will also be reflected in an improved level of customer service at the airports. 	<ul style="list-style-type: none"> • threats of terrorism in civil aviation have an indirect impact on the reduction of freight and passenger traffic. High aviation security standards are a prerequisite for the proper functioning and competitiveness of air transport; • military conflicts and economic sanctions imposed on some countries redirect air traffic and limit the number of passenger trips to third countries; • corona virus outbreak – the COVID-pandemic of the early 2020 and 2021 has led to a drastic reduction in passenger journeys, but the recovery process will be of key importance to building action plans in the event of similar events occurring in the future; • unfair actions of agencies which are in charge to help passengers to receive compensations under the Regulations. Such agencies need to be monitored by the national law enforcement authorities in order to minimize fraud cases; • limited airports’ capacity – the importance of air transport will continue to increase, leading to exhaustion of airport capacity and adjacent infrastructure.

Source: Concluded by the authors.

5. Evaluating the Impacts of Passengers’ Rights Protection Policy on the Competitiveness of Airlines and Airport Operators

Four variants for changing the current regulations have been considered for implementation and their influences have been evaluated by using the impact assessment model of passenger rights policy on the main indicators for airlines and airports performance. By using the dynamic programming approach, each variant is considered with separate sub-options and the benefits in terms of improving the quality of transport services and their influences on the competitiveness of carriers and airport operators are concluded. Based on this assessment, an optimal new variant 5 with the highest impact is derived by using the formula for calculating the maximum efficiency (F) of transport services in terms of measures to protect the rights of air passengers as follows:

$$F = \max \left[V \left(\frac{c \cdot x}{10} \right) \right] \quad (3)$$

where:

F – maximum efficiency

V – options for a different measure to be applied for passenger rights protection and changing EU Regulations

c – weighting factor of the variant

x – weighting factor of the effect.

The relative weighting factors of the expected effects of the measures’ implementation can be determined and a cumulative burden of the application effects for each option on the quality of air passenger services and the competitiveness of airlines and airport operators can be determined.

The use of this approach is presented in Table 3. For each option and for each measure included in it, impact weighting factors were calculated and thus, the options with the highest expected effect were assessed.

Table 3

Matrix for determining the effect of the application of different combinations of measures for protecting passenger rights

Variant 1	Variant 2.1	Variant 2.2	Variant 3	Variant 4	Variant 5	Effects b	Weighting factor of the effect x
0.6	0.3	0.3	0.3	0.3	1.2	Safety and Security	3
						Regularity and Accuracy	
						Comfort and Culture of Service	
0.4	0.2	0.2	0.2	0.2	0.8	Right to re-routing	2
0.2	0.1	0.1	0.1	0.1	0.4	Industry fund	1
0.2	0.1	0.1	0.1	0.1	0.4	Care	1
0.4	0.2	0.2	0.2	0.2	0.8	Compensation payments	2
0.2	0.1	0.1	0.1	0.1	0.4	Accommodation in a hotel	1
2	1	1	1	1	4	Weighting factor of the variant	10/10

Source: Authors’ own calculations

In applying the dynamic programming approach, the quality indicators related to security and safety of services, regularity, and accuracy of flights, as well as comfort and culture of service, are combined with a common coefficient as constant and mandatory parameters for compliance in all variants with higher weighting factors. The weighting factors are calculated as suggested by Jain and Gupta (2004) by using the SERVQUAL model based on estimated valuations of some service-quality attributes in an airline choice context using stated preferences methods and adapted to passengers' rights protection policy context by using per cent changes in the consumer perceptions for different variants (Skytrax, 2021). The different weighting factors reflect the examination of variations in values according to different characteristics of the service and the number of measures included in different variants by using the following formula:

$$Wf_i = \sum_{j=1}^k P_{ij} \quad (4)$$

where:

Wf_i – weighting factor based on the perceived importance of service quality and other measures for passengers 'i'; k – number of measures/items; P – perception of passengers 'i' with respect to the performance of a service with regards to passengers' rights protection 'j'. The higher the importance of the respective measure (service quality factor), the higher the weighting factor.

Respectively, the weighting factor of each variant is determined by assigning a different value for each effect (formula 3), allowing a clear distinction between possible improvements related to the protection of passengers' rights. The method considers a different number of effects of varying weighting factors, allowing identification of the variant with the highest coefficient. After analyzing the proposals, the effect of the application of different combinations of measures to protect passenger rights is determined.

The coefficients are obtained as multiplication of the weighting factors of the effect (x) and the weighting factors of the respective variant (c), based on which values are assessed for each variant and defined as high, medium, and low. The following assessment scale has been adopted: high – from 0,8 to 1,2; medium – from 0,4 to 0,7; low – under 0,3.

The effectiveness that is obtained for each variant depends on two factors – the measures at the beginning of the relevant stage and the behaviour of the airlines. The second factor is of particular importance, as some airlines justify their delays with exceptional circumstances without any evidence of such delays within the meaning of Regulation (EC) No 261/2004. In the context of the task assigned, the optimal behaviour of the airline carriers means that the greatest possible effect of these variants can be obtained only as a maximum of the coefficients (f).

It is apparent from the matrix that when analyzing air quality indicators, the headline objective is to open up opportunities for improvement with regard to regulations to protect passengers' rights and increase the competitiveness of airlines. Achieving this goal will have a positive impact on the demand for air services – and as a result on the reduction in the cost for compensations to airlines. Thus, a higher transport efficiency, respectively competitiveness of carriers and airport operators, will be achieved.

If the number of variants is V (in this case, $V = 6$) at $f_i(x_i)$, maximum efficiency of variants 1 and 2, and ..., and j obtained at a set value x and c . Therefore, the option that has the highest coefficients $f_i(x_i)$ by individual indicators is the most effective. The example considered suggested six variants and six effects, one of which is combined and amplified. For each variant, a value is calculated, assessing the effect of its implementation. The highest values give priority to the relevant variant. With constant requirements for compliance with the quality criteria relating to security and safety of transport, regularity, and accuracy of flights, as well as convenience and service culture, the use of the dynamic programming method will make it possible to assess the effect of the application of the different variants based on the different combinations of applicable measures and to choose the option, which ensures the highest economic benefits.

Table 4 presents the four variants examined by the European Commission and proposed to amend the current Regulation (EC) No 261/2004 to improve the application and enforcement of passenger rights, as well as one (variant 5), which is a combination and amplification of measures suggested in other variants. Each of the proposed variants has a different focus and different effects. Common for all variants is the quality of services indicators, which are constant and mandatory in the operation of air transport services without compromising them.

Table 4
Matrix for determining the effect of the application of different combinations of measures for protecting passenger rights

Variant 1	Variant 2.1	Variant 2.2	Variant 3	Variant 4	Variant 5	Measures
√	√	√	√	√	√	Safety and security
√	√	√	√	√	√	Regularity and accuracy
√	√	√	√	√	√	Comfort and culture of services
				√	√	Right to re-routing
			√	√	√	Industry fund
√**	√**	√**	√**	√**	√**	Care
above 5 hours	above 5 hours	above 3 hours	above 3 hours	above 3 hours	above 3 hours	Compensation payments
-	√*	-	-	-	√*	Accommodation in a hotel
2.1	9.8	9.6	11.3	11.6	9.88	Costs by variants (million euro)
8	18.4	17.5	26	26.2	19.22	Maximum costs ***

Note: * only for long delays over certain hours

** flight delay of up to 2 hours

*** if all passengers entitled bring an action for compensation

Source: Authors' own calculations

The first variant focuses on the economic incentives for air carriers. It envisages that passengers will not be entitled to re-routing in case of delay of a long flight, but it is mandatory for airlines to offer travel insurance to passengers at their request. This variant

does not provide for the establishment of an industry fund that will cover all the costs of providing care and compensation for passengers. At an earlier stage of the evaluations of the proposed options by the Commission, it was considered that the Fund would be ineffective, and its establishment would lead to additional administrative costs. The time threshold for compensation for flight delay in variant 1 has been changed from 3 to 5 hours. In such an option, passengers will only be entitled to care when the delay is more than 5 hours. The change in the payment of compensations by airlines is similar. Passengers will be able to claim compensation when they arrive at their destination 5 hours late or more. For long delays in this option, hotel accommodation is not included at the expense of the airline. With regards to 'exceptional circumstances', this option proposes a strict definition of events that are not the fault of airlines. The estimated costs of the Commission's estimate for this variant will amount to EUR 2,1 million to cover claims submitted to airlines.

Variant 2 has two sub-variants that are similar to the current Regulation, but the cost of compensation is foreseen to be limited when a higher number of claims for compensations are submitted by passengers. In this option, there will be no industry fund, and in case of delays, regardless of the reason, passengers will be entitled to care. In *variant 2a*, the time threshold for compensations for delays is increased to more than 5 hours, and in *variant 2b* it remains unchanged – for delays of more than 3 hours. Variant 2a includes hotel accommodation for passengers who have long delays of their flights. The current Regulation does not specify an exact definition of long delay. The estimated costs of implementing variants 2a and 2b are similar and amount to around EUR 9.8 million according to the Commission's calculations.

Variant 3 provides for the payment of compensation for delays of more than 3 hours. Measures such as the right to re-routing and hotel accommodation for passengers for delays of more than 3 hours are not included. This variant envisages the establishment of an Industry Fund to cover long-term emergency compensations. In situations of short delays, no right to care for passengers is provided. The estimated cost of this variant amounts to EUR 11,3 million.

In *variant 4*, the compensation threshold is for delays of more than 3 hours, as well as the right to care by the airline in case of shorter delays, is envisaged. In this option, just like in variant 3, an Industry fund is expected to cover compensations for delays of long duration. The difference between the two variants is that under variant 4, passengers can be re-booked with another airline to their destination, with costs covered by the Compensation Fund. No obligation is included for airlines to accommodate passengers in a hotel in case of long delays. The estimated cost of implementing this option amounts to EUR 11,6 million, which is the highest value of the variants under consideration.

Variant 5 (proposed by the authors) is a combination and amplification of the measures suggested in the other variants to protect passenger rights. Passengers will have a right for care in case of a flight delay of up to 2 hours and compensations are paid in case of a delay of more than 3 hours. Passengers will be entitled to re-routing when there are alternative flights to reach their destination with as little delay as possible. With such a choice by passengers, airlines will not have additional obligations to them. These measures apply in cases of overbooked flights, as well. In these cases, the search for volunteers starts at the

check-in desks as early as possible before the flight. Air carriers shall give priority to the transport of persons with reduced mobility and to all accompanying persons. The choice of the passenger who will be denied boarding shall be determined by the end point of travel. If the airline finds suitable alternative flights to reach its destination, the passenger is removed from their original flight and re-routed with another airline. Compensation shall be granted in the form of a cash compensation voucher depending on the distance of the flights and the time of arrival to the destination if the passenger arrives 2 hours or later from the original time of landing. So, the measures envisaged in this variant cover all the cases that could arise when a flight is overbooked. This variant also envisages the establishment of an Industry Fund to cover airline costs when passengers are accommodated in a hotel for long-term delays. The costs of this option are on average calculated based on the other options measures and amount to approximately EUR 9,88 million.

From an economic point of view, variant 1 is the most advantageous, but it has the lowest number of measures that apply to the protection of passengers' rights. The combined option of variant 5 is the next cost-effective one that builds on the European Commission's variants and reflects on improving the quality of the services offered, thereby helping to increase the competitiveness of airlines and airport operators. The main goal of the proposed variant 5 is, on the one hand, to ensure effective and consistent enforcement of air passengers' rights and, on the other hand, *to ensure an increase in the quality of services at optimal costs that will reflect increased competitiveness of airlines and airport operators*. This variant respects the basic principles of the application of the Regulations, as well as it provides for an extension of their scope, which will help to reduce disputes between airlines and passengers in specific cases. This, in turn, is expected to improve the coordination of enforcement policies carried out by the Member States.

6. Expected Impacts of Defined Measures to Protect Passengers' Rights

By using dynamic programming to assess the effectiveness of different variants for improving the air passengers' rights protection policy, a new combined and amplified variant has been developed that has optimal results in terms of the quality of transport services and the competitiveness of airlines and airport operators, based on the coefficients obtained by individual indicators and effects. This option is tailored to passenger rights without further burdening airlines from a financial point of view, while covering passenger losses due to flight delays. The airlines consulted have calculated the costs of paying compensation for delays on an annual basis, amounting to approximately EUR 800,000 (DG MOVE, 2020). The estimated costs of implementing each variant could be used to better decision-making by the European Commission and local law enforcement authorities when choosing a variant. A better solution would be the dynamic calculation of such costs by improving existing passenger re-routing tools. With assistance from other airlines that are members of the same alliance to reach the final destination of passengers, it would also provide airlines with greater savings (Cook, et al., 2009). The study provides estimates of these costs by variants, although more research is needed in this area.

The implementation of the amplified variant and the respective measures to improve the quality of services and protection of air passenger rights, derived by applying the dynamic programming approach, will provide opportunities to reduce delays, to increase airline efficiency, to improve passenger services' quality and to reduce the number of complaints related to flight delays. The necessity for a change in the Regulation on the protection of air passengers' rights is very important in order to increase the competitiveness of airlines and airport operators. The scientific and theoretical results obtained could make a significant contribution to improving the quality of air transport services through the proposed measures to protect passenger rights in different situations. Furthermore, the application of this approach aims to minimize the number of complaints made by air passengers, which has a significant impact on the competitiveness of airlines. The creation of a Compensation Guarantee Fund will help to limit this impact and will lead to lower airfare prices. Consequently, all proposed options for improving air passenger rights policy aim to ensure an improvement in the quality of the services offered by implementing different measures.

6.1. Economic impacts

Each of the proposed variants aims to increase the effectiveness of the passengers' rights protection policy. They provide for systematic checks on the organization of work and the management of the activities of air carriers to be carried out by national law enforcement authorities in the EU countries. The latter should monitor the compliance with the rules included in established action plans to respect the rights of passengers by the airlines in the event of emergencies.

Table 5

Financial impacts of the recommended measures

Impact of the full package of measures compared to the baseline scenario	Total costs at current claims levels (it is assumed that this will increase slowly over time)		Estimate of the maximum costs associated with the application of the Regulation (if all passengers entitled to claim compensation)	
	Net present value (2015-2025), million Euro	% change compared to base line	Net present value (2015-2025), million Euro	% change compared to base line (existing policy measures)
Base line	10.4	-	23.6	-
Variant 1	2.1	-80	8	-66
Variant 2a (unchanged compensation levels)	9.8	-6	18.4	-22
Variant 2b (unchanged compensation levels)	9.6	-8	17.5	-26
Variant 3	11.3	9	26	10
Variant 4	11.6	12	26.2	11
Variant 5	9.88	-15	19.2	-19

Source: Based on the authors' idea and adapted from 'Steer Davies Gleave' study.

As shown in Table 5, coordination between national enforcement policies increases from option 1 to option 5, but the associated administrative costs also increase (Steer Davies

Gleave, 2012). In all policy variants, the existing rights of air passengers are clarified, especially regarding the concept of exceptional circumstances, reducing the possibilities for interpretation.

For variants 2 and 4, the policy is further simplified by introducing the measure, which assumes that the provision of food and drinks is provided whenever a delay of two hours, regardless of the distance of the flight and the reason for the delay.

- *Impact on compliance costs*

Under Variant 1, the compliance costs will be significantly reduced. A long-duration emergency event will have only a limited impact – and costs will remain unchanged for regional carriers. In variant 2 (and its sub-variants), the costs will remain almost unchanged, and their potential for rising will be limited to cases where more passengers claim compensation or in an extraordinary event of a long duration. Costs for regional carriers will be similar to those for other air carriers. For variants 3 and 4, the costs will be similar to the baseline, but with a higher potential for rise in cases where more passengers claim compensation. There will be a cost limit for compensations in case of a long-duration extraordinary event, and costs of regional carriers will remain at very high levels compared to their revenues. Airport operators and other third parties could share some of the costs of air carriers as the above mentioned four variants give air carriers more options to file compensation claims for costs incurred to third parties responsible for delays or cancellations.

In variant 5, the costs are slightly lower than the baseline, provided that the payment of benefits over distances of up to 1500 km is accepted to be reduced from EUR 250 to EUR 200, which would result in a 15 % reduction compared to the basic amount. The estimate of the maximum costs associated with the application of the Regulation would decrease by 19% compared to the baseline if all passengers were entitled to protection claim compensation. The impact on small and medium-sized aviation companies is very limited as only a few of them are affected by the Regulation. Most of them will benefit from the proposed specific measures for small-scale operations (short flights) to variant 2.

All policy options entail some new administrative costs for air carriers (mainly related to the preparation of contingency plans) and national enforcement authorities – mainly related to the implementation of the proactive policy, the costs of which could be offset by a reduction in the number of complaints and respective costs.

6.2. *Social impacts*

- *Impact on consumers*

From a social point of view, all variants considered have common characteristics: better enforcement of passengers' rights (including baggage); improved procedures of handling individual claims; clarifying and enhancing passenger rights. The measures provided for in variant 1 are aimed at reducing air carriers' obligations to passengers during traffic problems by extending the scope of exceptional circumstances. Although passengers may choose insurance depending on their individual situation, many passengers, in view of the low rate of delays and cancellations, may not properly assess the risk of the occurrence of different

events. In such situations, passengers will not be compensated in the case of possible flight delays.

In variant 2, the obligations to provide care and assistance are increased, but the right to financial compensation is partially limited. It will rely on national enforcement authorities to implement and protect passengers' rights. Moreover, passengers will not be well protected in the event of long-duration emergency events (excluding passengers with reduced mobility) and on regional flights. However, this is offset by better implementation of existing rights.

Variants 3 and 4 envisage many advantages for passengers, such as increasing and better fulfilling of their rights. Nevertheless, the change may result in slightly higher ticket prices, which will contribute to covering the higher performance costs.

Variant 5 includes amplified measures relating to passenger rights in different situations. The establishment of a Guarantee (Industry) Fund proposed in this option will alleviate the financial consequences for airlines but will also cover more situations in case of passenger flight problems. The right to re-routing will help to reduce the number of missed connecting flights and fewer passengers will remain stranded for a long time at airports.

- *Impact on employment*

For the first four variants, impact on the employment remains limited as they are mainly aimed at improving existing passengers' rights protection and better ensuring implementation. In variant 5, the proposed measures can have a positive impact in terms of employment. The reason for this is the extension of passengers' rights, which will improve the overall quality of air transport services and attract greater passenger traffic. This will create prerequisites for the creation of new jobs for the passenger services by ground handling and airport operators, crew, etc. However, it should be considered that the variants of the policy measures applied should not have an adverse impact on the fundamental rights of citizens.

6.3. Environmental impacts

The impact of the proposed policy options to protect passenger rights on emissions remains limited. However, account should be taken of the main objectives of EU transport policy related to the growing concern for environmental protection and reduction of harmful effects. The International Civil Aviation Organization (ICAO) plays an important role in finding solutions to reduce harmful emissions from air transport (Official Journal of the EU, 2014). The EU is trying to establish a market mechanism to achieve zero carbon growth and adopt an environmental certification standard for aircrafts. The environmental parameters of the Single European Sky air traffic management project are expected to contribute to reducing harmful environmental impacts through fuel savings, potentially leading to a decrease of around 50 million tons of carbon emissions. The passengers' rights protection policy as a part of this project could contribute to the achievement of the goal.

6.4. Policy impacts

The Commission envisages a proper assessment of the implementation of new passengers' rights protection policy measures four years after their adoption by the Council and the European Parliament. The annual reports of National Enforcement Authorities will be the main tool for monitoring the level of compliance and coherence of national enforcement policies. It is necessary for the Commission to draw up regular reports on the basis of national reports, complemented, where necessary by its own experience, ad hoc studies, or information from passenger studies. Attention should be paid to the emerging problems identified by national enforcement authorities related to cases of fraud by intermediary agencies for the payment of compensations.

As a result of the systematization of existing problems, it can be summarized that the general objective of the passengers' rights protection policy is to promote the interest of air passengers by ensuring that operators comply with the high level of passenger protection in the event of traffic problems and will operate under harmonized conditions in a liberalized market. This general objective may be decomposed further to the following specific sub-objectives:

- To ensure effective and consistent enforcement of passengers' rights protection across the EU by clarifying definitions and basic principles relating to passengers' rights protection and simplifying rights; effective and coherent sanctioning policy; ensuring an effective complaint handling procedure and legal protection for passengers;
- To reduce the disincentive impact of certain costs on air carriers by ensuring that the obligations of air carriers with regards to passengers' rights cover risks that are limited in time and/or in size; in some cases, financial compensation does not strongly discourage compliance; the Guarantee Fund shall cover the cost for compensation to airlines in situations not entirely caused by the fault of carriers; third parties are encouraged to address the causes of traffic problems for which they are responsible for.

The revision of passengers' rights protection policy measures is of particular importance for the competitiveness of airlines and for striking a fairer balance between the interests of passengers and airlines. Many of the new elements, if adopted, will alleviate the financial costs for carriers, increasing their efficiency and competitiveness. This, in turn, will contribute to improving the quality of the services offered by reducing delays.

Therefore, proposals for amendments to the passengers' rights protection policy will contribute to the development of air transport and, even if adopted, updates will be needed through constant monitoring and analysis of situations that have led to flight delays in order to improve the implementation of the passengers' rights policy. An example is Regulation 0072/2013, which was developed as early as 2013 but is no longer effective enough due to dynamic changes in the air sector.

6.5. Impacts on the aviation industry

One of the main objectives of air transport development policy is to ensure a high level of passengers' protection. To achieve this objective, it is important to take account of what has

been achieved so far and to build on it so as to be able to meet the requirements for the protection of passengers' rights when using air transport. Inconvenience, anxiety, and stress are some of the consequences for passengers in situations of denied boarding, long flight delays or cancellations. It is therefore of particular importance that the EU raises the standards of passengers' protection established by Regulation (EC) No 261/2004 and ensures that air carriers operate under harmonized conditions in a liberalized market.

The passengers' rights protection policy applied was last reviewed in 2013, but without adopting any changes. This means that since 2004 there have been uncertainties and gaps in the scope of the regulations to be filled. The analysis of the Regulation applied provides an assessment and an opportunity to extend its scope through the proposed measures in variant 5 above.

The main priorities of the European Commission's aviation strategy are to keep air transport competitive while maintaining high standards of security and safety. It is necessary to develop an efficiency-oriented risk assessment system aimed at closing existing safety and security gaps. These key air services' quality indicators are important, and the European Commission has planned actions in the areas of creating highly skilled aviation jobs, protecting passenger rights and measures related to air pollution, caused by air transport.

The proposed measures will incentivize airlines to avoid flight delays by optimizing flight plans and providing sufficient time for land handling by ground operators. At the same time, increasing competition is forcing many airlines to reduce their operating costs by outsourcing basic and side-by-side operations to external operators and contractors. This may, on the one hand, reduce the service time of a flight and be more efficient for airlines, but on the other, the service time may not meet the technological minimum, which is a prerequisite for delays and an increase in the number of complaints.

In addition, the implementation of a targeted and systematic policy for the protection of passengers' rights must consider modern trends and conditions of the development of air transport and the emergence of alliances of air carriers. The main benefits of alliances for their members are related to offering an expanded network of destinations through code-sharing agreements; reduced costs due to the sharing of offices, maintenance facilities, operating facilities, catering and computer systems, operational staff – ground staff, check-in staff and boarding points; ensuring investment savings and purchase costs when negotiating additional reductions in the volume of transport. Moreover, the alliances provide the so-called 'sophisticated customers', with more opportunities to make the relationship "company-client" a form of experience beyond the rational framework of market exchange and thus they provide for the resolution of the contemporary challenges for the airlines related to the socially responsible branding and consumer loyalty (Georgieva & Stanimirov, 2021). These benefits provide additional opportunities for alliance members in the enforcement of passengers' rights protection policy and joint solidary liability and assistance to passengers in all cases where their rights have been infringed and claims for liability have been lodged. In this regard, alliances ensure that their members are provided with opportunities to reduce the cost of compensation and to service passengers' rights guarantee processes. All this helps to provide a higher quality of passenger air transport services, to improve the interaction

between carriers in passengers' rights protection procedures and thus, contributes to the high competitiveness of airlines in the air transport market.

7. Conclusions

The most important issue examined in this article and the novelty suggested by the authors are related to the application of a dynamic programming approach for evaluation of the impacts of passengers' rights protection policy on the competitiveness of airlines and airport operators. The authors argue that the improvements in the policy for the protection of air passengers' rights could contribute to an increase in the degree of competitiveness of airlines and airport operators. They summarized appropriate measures for the improvements in the passengers' rights protection policy based on the main quality indicators for air transport services and suggesting the usage of a dynamic programming approach for evaluating their impacts on the competitiveness of airlines and airport operators. The main objective fulfilled by using the dynamic programming approach is to ensure effective and consistent implementation of the air passengers' rights protection policy. The authors provide a comparison between different variants for improvements in this policy. They propose a new option to improve the policy by implementing the basic principles with the provision for an extension of their scope to contribute to reducing disputes between airlines and passengers in specific cases, thus providing a decrease in the costs for compensations and additional economic, social, and financial benefits for airlines and costumers. Airlines, airports, air traffic management, ground-handling services and other transport services are interconnected and must cooperate effectively to meet the real demand for flights even in specific situations such as the COVID pandemic.

The implementation of variant 5 as suggested by the authors, including measures for improvement of air passengers' rights protection policy, which also provides for quality improvement measures derived from dynamic programming approach, will help to reduce delays, to increase airline efficiency, to improve passenger service quality and to reduce the number of complaints about flight delays, thus providing lower costs for compensations and other economic, social, and financial benefits to airlines and their clients. The study provides arguments that the need to improve and broaden air passengers' rights protection policy through competitive and clearly justified measures is of particular importance to increase the competitiveness of airlines and airport operators.

The proposed approach for assessing the impacts of passengers' rights protection policy on the quality and competitiveness of airlines and airport operators provides an opportunity to identify individual options for improving this policy according to their effect and financial burden on air transport undertakings and selecting the one that will ensure the achievement of a higher quality of services and that increase the competitiveness of airlines and airport operators.

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THE SYSTEM OF EVALUATION EFFICIENCY OF THE STRATEGY OF SUSTAINABLE DEVELOPMENT OF THE ENTERPRISE IN THE DECENTRALISATION CONDITIONS⁶

The article proposes a scientific and methodological approach to strategising the development of a manufacturing enterprise in a decentralised environment based on the principle of feedback. This approach involves taking into account the direct and feedback indicators of the enterprise, aimed at increasing its competitiveness and achieving sustainable development goals. The authors propose to assess the level of development of the production enterprise in decentralisation, taking into account the multiplier effect of interaction with the united territorial community on the basis of the target approach (indicators are distributed according to the goals of the enterprise), taking into account the main directions of sustainable development component, each of which has its own system of evaluation indicators.

The proposed methodological approach to assessing the level of development of a production enterprise in decentralisation allowed to assess the development of the enterprise in accordance with its qualitative and quantitative characteristics in each of the areas of sustainable development (social, economic, environmental, budget), taking into account their interaction levels. A scientific and methodological approach to modelling the management system of the dynamic state of the production enterprise in terms of decentralisation, which provides for the formation of a model of development of the production enterprise in cooperation with OTG on indicators of its development. The model of management of development of the industrial enterprise in the conditions of decentralisation for LLC TIS, which is located in the territory of the Vizyr UTC of the Odessa region is constructed.

Keywords: sustainable development strategy; decentralisation; territorial community; comprehensive assessment of the strategy

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1. Introduction

In order to build a well-designed long-term strategy for the development of production enterprises in cooperation with the region, a comprehensive analysis of the state of the integrated structure as a whole and the development of an optimal set of management influences taking into account production, financial and other available capabilities, as well as an assessment of the forecast results and state of territorial and industrial education taking into account the formation of strategic plans for both the region and production enterprises. The analysis of the state of the production enterprise is based on the assessment of a set of factors and business indicators covering various types of enterprise activities and their impact on the sustainable development of the territory. At the same time, the assessment should be carried out in comparison of the position of the production enterprise with the position of other business entities operating in the same markets and producing the same products (services).

2. Literature Review

Sustainable development has traditionally been defined as development that “meets the needs of present generations without compromising the ability of future generations to meet their own needs” (Elkington, 1997). Thus, it is associated with the process of achieving the goal of steel, in which economic growth, social responsibility and environmental protection constitute the so-called concept of the triple criterion (“triple bottom line” or in the English version of “triple bottom line” (Elkington, 1997)) and are considered as single-level, mutually complementary.

Among the specialists, Lozano was recognised and interpreted (Lozano, 2012) who, considering the company in the context of its stakeholders, defined corporate constancy as a corporate activity that aims to ensure balance, including the economic, environmental and social aspects of today, as well as their relationship in the strategic planning period.

By analysing the literature on constancy in the business context, at least four approaches can be identified. Proponents of one equate constancy with sustainable development (Banerjee, 2003; Lankoski, 2016; Villiers, 2016). And, therefore, socio-environmental guidelines are necessarily considered. In another approach, corporate constancy is interpreted as a synonym for corporate social responsibility (Hediger, 2010; Montiel, 2008; Okoye, 2009). According to the third approach, the concept of constancy should be directly related to long-term business competitiveness (Lozano, 2015; Saltzman, Ionescuc-Somers, Steger, 2005; Hopkins, 2009). Authors who share this view attribute a sustainable competitive advantage to the concept we analyse. Proponents of the fourth approach, the concepts of constancy refer exclusively to a higher level, in relation to the micro-level, arguing that individual enterprises cannot be sustainable. In general, within the framework of this direction, a corporate organisation is invested, and it contributes to the achievement of sustainable development of large systems (Jennings, Zandbergen, 1995). This diversity of approaches may raise problems and questions that require further research.

3. Materials and Methods

The following methods were used in this study: economic-statistical and regression analysis – to study the development potential of Ukrainian production enterprises, assess the impact of production development and regional decentralisation on the economic growth of united territorial communities; optimisation methods and mathematical models of dynamic development management - to substantiate the generalised statistical indicators of monitoring and evaluation of the implementation of development strategies of industrial enterprises in the context of decentralisation; cascading method – to build a comprehensive model of strategising the development of industrial enterprises in a decentralised environment; expert assessments - to determine the consistency of the strategic goals of development of the production enterprise with the target program documents of the united territorial community.

4. Results

Since the basis of sustainable development, as well as social responsibility, is the parity of relations in the human-business-nature chain, the basis for building the concept of social responsibility of an enterprise in the 21st century should be the principles of a strategy for sustainable development of an enterprise. In fact, we are talking about the transition from the current “economy of the use of resources” to the economy of their systemic reproduction. A condition for the transition to sustainable development is the organisation of interaction of resource subsystems. The natural scene of such interaction is the territory. To do this, however, they must not only respond to the proposals of enterprises, but themselves lead them, producing holistic environmental complexes and individual areas of the territory that are specially equipped for the activities of enterprises.

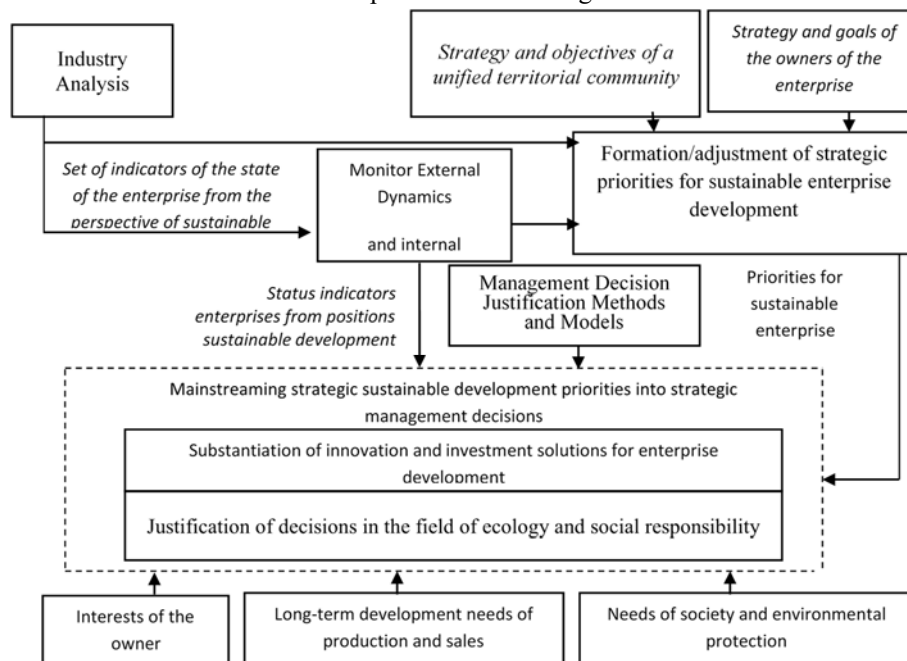
Therefore, sustainability – is the ordering of technical, scientific, environmental, economic and social resources in such a way that the resulting system is able to be maintained in a state of equilibrium in time and space.

To achieve sustainable development requires a comprehensive approach: environmental security (preservation and restoration of natural ecosystems, stabilisation and improvement of the environment, reducing emissions, etc.), economic stability (creating a socially and environmentally efficient economy that ensures a decent standard of living, increasing product competitiveness), social welfare (increasing life expectancy, family planning and rationalisation of personal consumption, improving the living environment of people, developing the social activity of citizens, ensuring equal opportunities for health care, social protection of vulnerable population groups).

The concept of strategic management of a manufacturing enterprise, which ensures sustainable development in a decentralised environment, is able to be represented in this way (Figure 1). Socially and environmentally responsible behaviour in the part that exceeds formal obligations becomes relevant in the presence of sufficient free resources and the absence of significant negative impact on the financial performance of the enterprise. An example of the manifestation of such an approach of responsible behaviour of the enterprise

will be the direction of part of the profits for the implementation of environmental measures or landscaping.

Figure 1
Conceptual model of strategy for sustainable development of the production enterprise in cooperation with the region



Source: author development.

Decision-making in these areas is considered comprehensively and interconnected, as well as taking into account the interests of owners and development strategies of the united territorial community in the territory of the enterprise. It is necessary to find a balance between investments in different areas of interest of owners and local authorities and their focus on the implementation of social and environmental projects in the area.

The specifics of the relationship between industrial enterprises and the united territorial community that are part of the territorial-industrial formation as a system and their impact on its sustainability require the development of a scientific and methodological approach to developing and monitoring the effectiveness of sustainable development strategy. Therefore, the authors propose a scientific and methodological approach to strategising the development of a production enterprise in a decentralised environment, based on the use of methods of systems approach and systems analysis, the object of study is considered as a set of interacting objects and relationships between them and takes into account the impact of a set

of factors on the sustainable development of the production enterprise in the context of decentralisation

The concept of strategy for sustainable development of the enterprise in the context of decentralisation, its conceptual model, developed (Figure 1), is based on management decisions based on a set of targets formulated as a compromise between the achievement of the goals of the owners of the enterprise, standard financial and economic indicators and priorities of sustainable development of the enterprise, formulated taking into account the sectoral characteristics and sustainable development needs of a certain.

The concept is based on the formalisation of the main priorities of sustainable development of production enterprises, combined with an assessment of the impact of planned decisions on the dynamics of the identified priorities, aimed at making balanced management decisions taking into account the interests of the owners of enterprises, priorities for the long-term development of resource support, production and marketing, the needs of the population of the territory, protection of the environment.

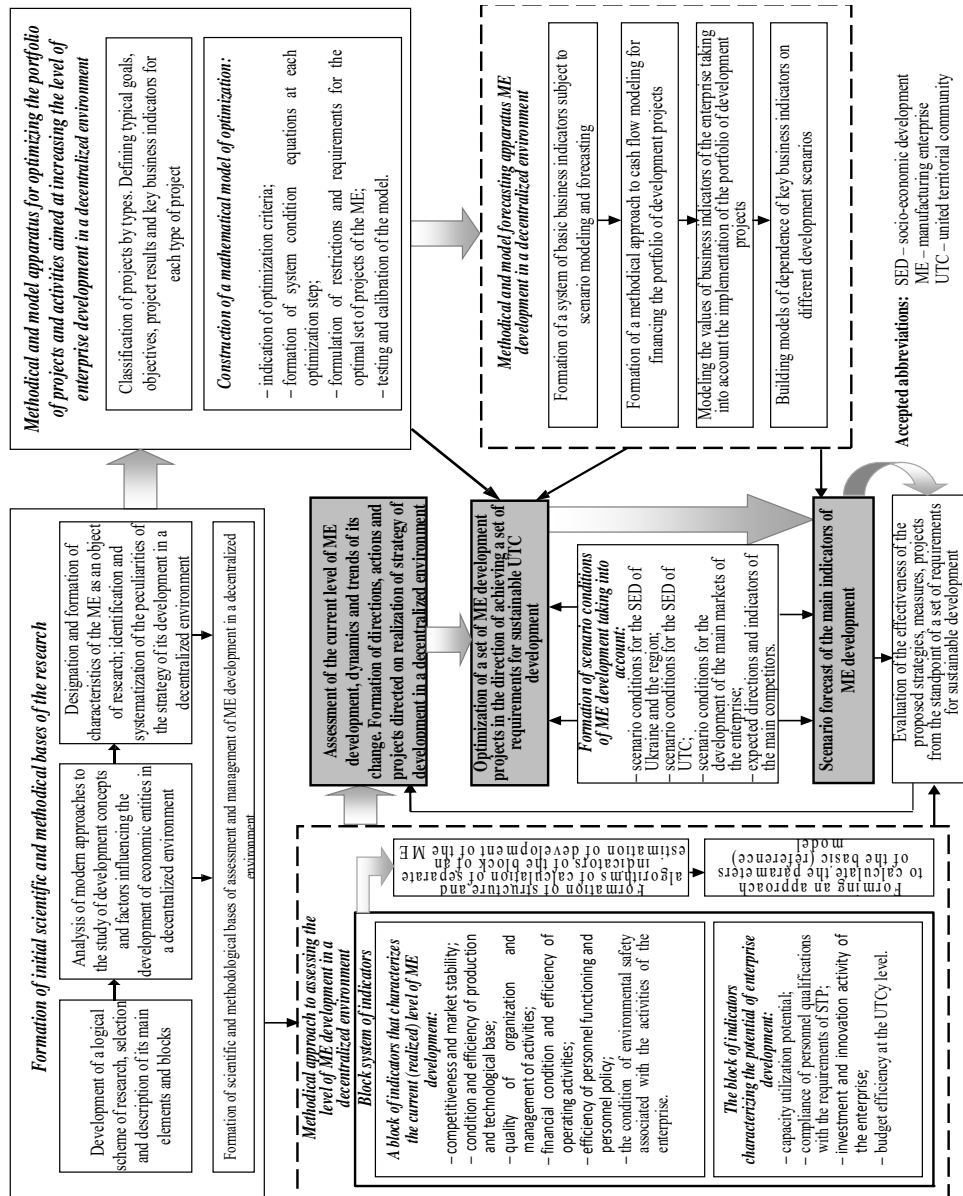
The study proposes a scientific and methodological approach to the strategy of development of a production enterprise in a decentralised environment based on the principle of feedback, when direct and backward linkages of enterprise performance indicators and management influences aimed at increasing its competitiveness and achieving sustainable development goals are taken into account, it was possible to identify three components that support three blocks of analytical tools (Lozano, 2015):

- 1) a unit for assessing the current state of development of a production enterprise by economic, social, environmental and budgetary indicators of activity and assessing the impact of its functioning on the sustainable development of a united territorial community;
- 2) project portfolio optimisation unit in order to implement the development strategy at the lowest risk and highest return;
- 3) a block for forecasting the state of development of a production enterprise in the conditions of decentralisation, taking into account scenario conditions for the development of the domestic and world economy, the region and the united territorial community (Figure 2).

The quantitative assessment of the sustainable development of the productive enterprise and territories is based on a set of measured indicators and indicators for regular monitoring of the situation, which makes it possible to identify the missing areas of monitoring that need to be monitored in order to achieve the overall goal of improving the level of sustainable development.

Therefore, the authors propose to assess the level of development of the production enterprise in the context of decentralisation, taking into account the multiplicative effect of interaction with the united territorial community, based on a targeted approach (indicators are distributed according to the goals of the enterprise), taking into account the main areas of sustainable development, namely the economic, social, environmental and budgetary components, each of which has its own assessment indicator system.

Figure 2
Scientific and methodological approach to strategising the development of a manufacturing enterprise in a decentralised environment based on the principle of feedback

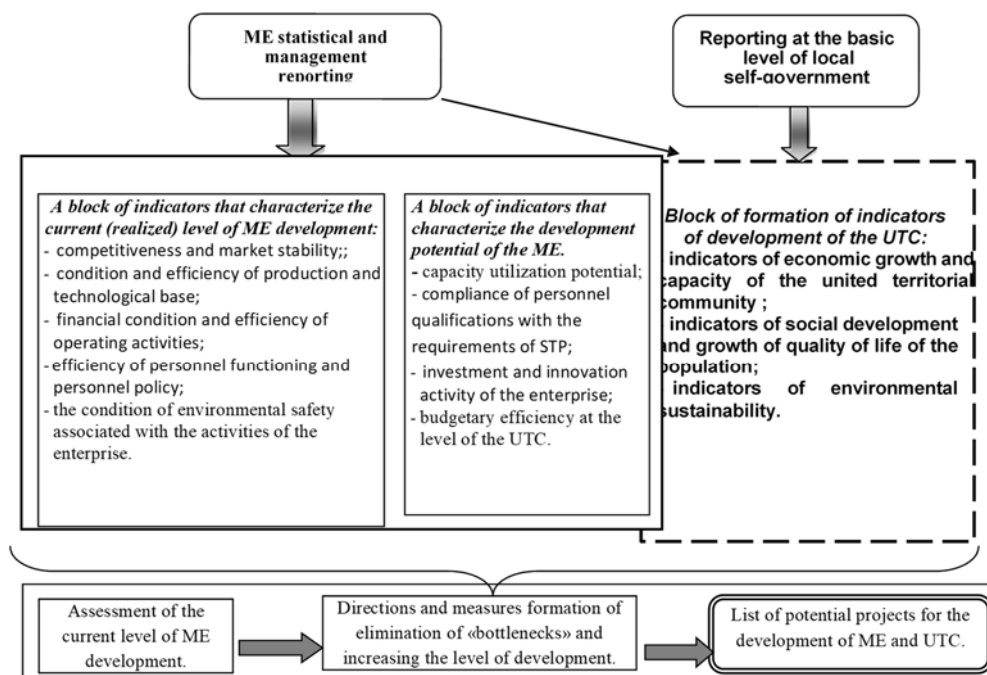


Source: compiled by the authors.

A methodological approach has been developed to assess the current state of development of a manufacturing enterprise in the context of decentralisation, which aims to determine its position in the socio-economic environment, taking into account the identified main projections of development, as well as the possibility of its further influence on the sustainable development of the united territorial community (Figure 3).

Figure 3

Logical scheme for assessing the state of development of the production enterprising the context of decentralisation



Source: compiled by the authors.

The methodological approach is based on the following scientific principles:

- Consistency, which allows you to formulate a set of interconnected indicators, which characterise the developmental aspects of the activity of a viral enterprise and, in short, start a new development;
- hierarchy that allows to aggregate indicators in the integrated development index, on the one hand, and factor analysis of the development of the production enterprise to identify the causes of the situation, on the other;
- Complexity, which allows to take into account a set of factors influencing the development of the production enterprise in terms of decentralization;

- Universality, which allows to apply a methodological approach to assess the activities of any manufacturing enterprise, subject to adaptation to the specifics of its activities;
- Transparency, which allows the inclusion in the study of additional indicators depending on the specifics and conditions of the investigated production enterprise;
- interdependence, which consists in taking into account the direct and inverse interconnections between the condition of development of the studied manufacturing enterprise and the influences of management aimed at increasing the level of its development in a decentralised environment.

The assessment of the level of development of the production enterprise in the context of decentralisation involves six stages (Figure 4).

At the first stage, the analytical base of the system of estimates of the production enterprise in the context of decentralisation is compiled. At the same time, information material is selected on the results of functioning of the analysed objects and calculations of the selected indicators are carried out on the basis of established criteria.

Assessment of the current condition of development of the production enterprise in a decentralised environment is designed to solve the following tasks: 1) identification of strengths and “bottlenecks” in the development of the production enterprise; 2) determination of the main directions of development of the production enterprise and “points of influence” on the sustainable development of the UTC.

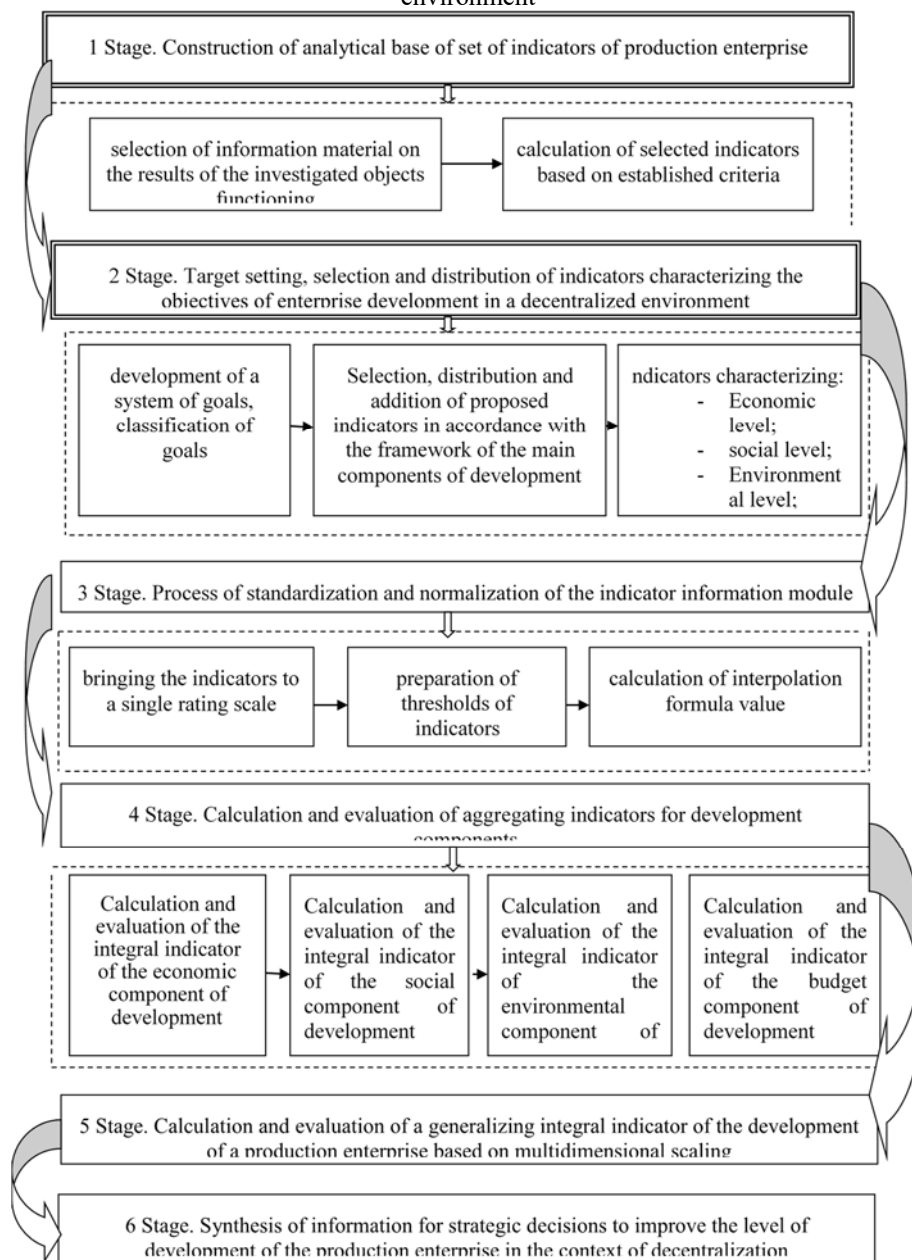
In accordance with the methodological approach, all the activities of a production enterprise in the context of decentralisation are divided into several enlarged blocks:

- competitiveness and market sustainability;
- the state and efficiency of the production and technological base;
- financial condition and operational efficiency;
- innovative and investment activity of the enterprise;
- effective functioning of personnel and social policy of the enterprise;
- state of environmental safety related to the enterprise activity;
- budgetary efficiency of the enterprise at the level of the united territorial community.

The input to the process of assessing the current state of development of the production enterprise is statistical and management reporting, which characterises various aspects of the activity.

Figure 4

Methodology for assessing the development of a production enterprise in a decentralised environment



Source: author's development.

At the second stage, the objectives of the enterprise are set, their grouping in qualitative and quantitative areas, while considering the levels of economic, social, environmental and budgetary sustainability. The effectiveness of the development assessment depends on the correctness of the goals and goals of sustainable development, the assessment of the factors influencing the activities of the enterprise and the clarity of the choice of its direction of development. To strategy sustainable development and further assess its level, it is necessary to develop a system of interacting indicators of the enterprise's production and economic activities and indicators of its stable growth and development, based on the principles of completeness, reliability, quality of information, which will make it possible to make effective management decisions.

The authors proposed the following group of indicators in Table 1.

It is proposed to include only those indicators that correspond to the strategic development goals of the studied enterprise, which allows reducing the number of indicators; takes into account the specificity and objectives of the enterprise development; identifies the cause of the failures of their achievement.

Thus, a distinctive feature of the proposed methodological approach for assessing the level of development of a production enterprise in a decentralised environment is a targeted approach that allows assessing the development of an enterprise in accordance with its qualitative and quantitative characteristics in each of the areas of sustainable development (social, economic, environmental, budgetary), while considering their interaction by levels.

The third stage consists of the processes of standardisation and normalisation of the information module of indicators and bringing them into one dimensionless form, which is the necessary procedure for eliminating the influence of differences of different indicators when they are combined into an integral assessment, while using and using methods that allow calculating the normalised value of zero and negative indicators. The statistical practice has developed many versions of the standardisation procedure, in particular, the classical way, the way of relations, standardisation by varying scale, the choice of which depends on the purpose of the study, the statistical nature of the primary indicators and their socio-economic content (Table 2) (Beltyukov, Dyskina, 2013).

The fourth stage consists in the definition of generalising indicators for the development components of the production enterprises under study in the context of decentralisation (economic development, social development, environmental and budgetary efficiency), taking into account the specifics and strategic aspects of their activities on the basis of multidimensional scaling.

Table 1

System of indicators for assessing the level of development of a manufacturing enterprise in a decentralised environment

The part of development		Indicators for assessing the level of development of a manufacturing enterprise in a decentralised environment
Economical development	Market stability	The growth rate of production, %; Sales growth rate (due to the expansion of markets), %; Market share, %; The growth rate of the number of employees, %.
	Production stability	The growth rate of fixed assets, %; Return on assets, UAH/ UAH; Depreciation rate of fixed assets; The growth rate of labour productivity, %.
	Financial and economic stability	The growth rate of the financial result, %; The rate of reduction of the cost of products (services), %; Autonomy ratio; Total liquidity ratio; Solvency ratio; The level of return on assets, % The level of profitability of production, % The level of profitability of sales, %
	Innovation and investment activity	The share of intangible assets in the structure of assets, %; Number of advanced technologies created, un.; Number of advanced technologies used, un. The share of innovation costs in the total costs of the enterprise, %; The share of sold innovative products in the total sales, %; Fixed assets renewal ratio. The amount of investment in fixed assets, thousand UAH; Volume of investments in R&D, thousand UAH
Social development	The size of the average monthly salary (coefficient); Staff turnover ratio; Staff dropout rate; Total morbidity rate; The share of highly qualified employees, %; Number of employees who have undergone professional retraining, training, persons;	
Environmental sustainability	The share of low-waste and resource-saving technologies in the total number of technologies at the enterprise, %; Material consumption ratio; Energy consumption ratio; The rate of reduction of harmful emissions, %; Expenditures on environmental protection measures, thousand UAH.	
Internal budget efficiency	The amount of revenues to the budget of UTC from the payment of personal income tax, thousand UAH; The amount of revenues to the UTC budget from the payment for land, thousand UAH.; The amount of revenues to the UTC budget from the payment of real estate tax, thousand UAH.; Fees and other payments to the UTC budget.	

Source: compiled by the authors.

Table 2

Basic methods of standardisation of indicators

Method of standardisation	The nature of the impact of indicators		Legend
	Stimulants	Destimulators	
The classic method of standardisation	$z_i^j = \frac{x_i^j - \bar{x}_i}{\sigma_i}$	$z_i^j = \frac{\bar{x}_i - x_i^j}{\sigma_i}$	\bar{x}_i – average value; σ_i – standard deviation
The method of relations	$z_i^j = \frac{x_i^j}{a}$	$z_i^j = \frac{a}{x_i^j}$	$a = x_{\min}; x_{\max}; x_{em}; \bar{x}$ – minimum, maximum, standard or average value
Standardisation on a variational scale	$z_i^j = \frac{x_i^j - x_{\min}}{x_{\max} - x_{\min}}$	$z_i^j = \frac{x_{\max} - x_i^j}{x_{\max} - x_{\min}}$	$x_{\min}; x_{\max}$ – minimum or maximum value.

Source: Beltyukov, Dyskina, 2013.

The main and important features of the method of multidimensional scaling as a tool for combining individual indicators in the group is as follows (Figure 5).

- 1) Information on the similarities and differences of enterprises is determined in the n-dimensional space of the initial features, i.e. simultaneously for all primary indicators in the context of each pair of enterprises (stage 2 of the picture).
- 2) The problem of combining uniform estimates in general (determining the coordinates of comparison objects in a new space of smaller dimension /spaces of latent features/, stages 3 and 4 of the picture) forms as an optimising problem that solves the help of special optimisation methods. The optimisation criterion is the minimum value of «stress» (an indicator that reflects the level of similarity of the proximity matrices d and D), which provides the maximum possible level of preservation of the degree of similarity and diversity of objects in the new space of smaller size.
- 3) The method of multidimensional scaling is calculated on the basis of both interval and ordinal values. Accounting for the nature of the primary indicators is determined in the process of optimisation by accounting for ordinal values only for the requirement of maintaining order.

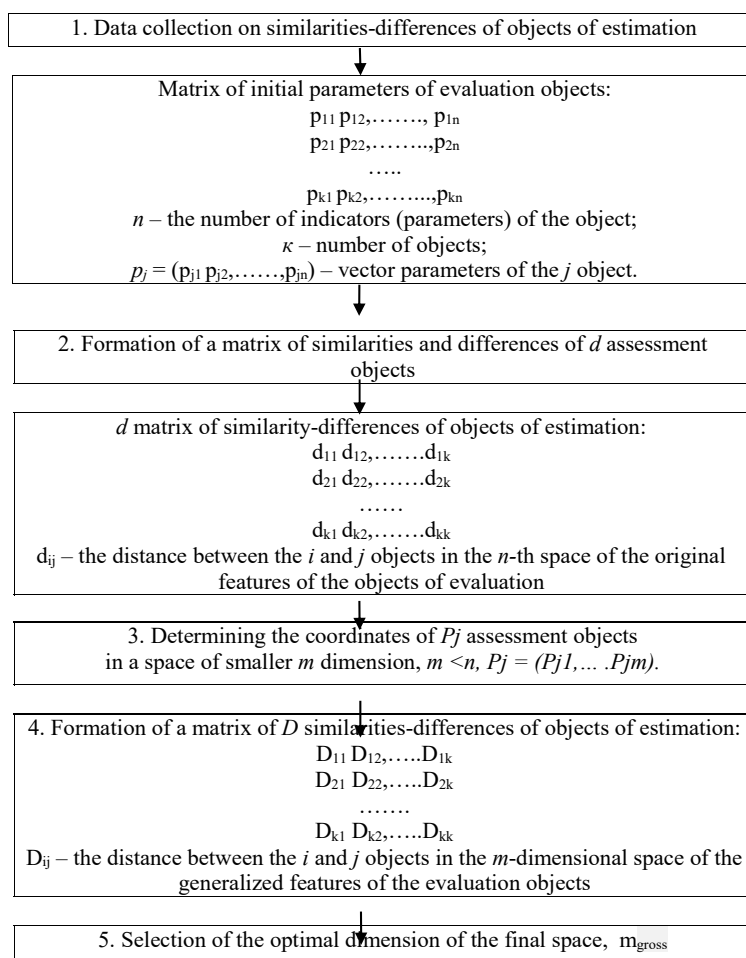
The multidimensional scaling method fully fits into the generally accepted comparison scheme, which is based on the analysis of a larger set of heterogeneous factors and development indicators, the consistent generalisation of the initial parameters of the evaluation objects into a group and integral ones based on the corresponding classification of these factors and indicators, offers a fundamentally new, effective, scientifically justified.

At the *fifth stage*, a generalising (integral indicator) of the development of a production enterprise in a decentralised environment is calculated using the PROXSCAL multidimensional scale application package, which allows you to assess the level of

enterprise development not only in terms of goals, but also in four components: economic, social, environmental and budgetary.

Figure 5

Scheme for assessing the development of the enterprise using the method of multidimensional scaling



Source: Beltyukov, Dyskina, 2013.

The first range of the integrated indicator (high level of development) is the absolute and high level of sustainability of the production enterprise. Factors that reduce the resilience of development may be identified in this range. The second range of values of the integrated indicator (average level of development) characterises the sustainable development of the

production enterprise and warns of violations of sustainable development. The third range of values of the integrated indicator (moderate level of development) reflects the negative trends occurring in the enterprise, and warns of threats to economic security and approaching a crisis. The fourth range of values of the integrated indicator (low level of development), which is below the extreme normative value, is a zone of crisis in which the balance and sustainable development of the production enterprise is disturbed and the processes leading to complete collapse begin.

The sixth stage, as a result of the process, defines strategic guidelines for the development of the production enterprise in the context of decentralisation, which is the basis for the development of a combination of innovative and investment projects for the sustainable development of the enterprise and the unified territorial community (Niekrasova, Chukurna, Dobrianska, Izmaylov, Shkrabak, Ingram, 2020).

Based on the developed methodological approach to assess the level of sustainable development of the production enterprise, the level of development of budget-forming enterprises of the Vizirska united territorial community (UTC) of the Odessa region was evaluated. Data from enterprise reporting were used to calculate indicators of economic, social, environmental and budgetary blocks for quantitative purposes. The value of the integrated indicator for assessing the level of development of enterprises of the Vizirska united territorial community (UTC) is summarised in Table 3.

Table 3

Comprehensive indicator of assessment of the level of development of enterprises of Vizirska united territorial community (UTC) for 2016-2020

№	Enterprise	Integrated indicator				
		2016p/place	2017p/place	2018p/place	2019p/place	2020p/place
1	LLC «TIS COAL»	0,63/2	0,46/2	0,39/3	0,45/2	0,46/2
2	LLC «TIS – KT»	0,75/1	0,38/3	0,48/2	0,37/3	0,41/3
3	LLC «TIS»	0,45/3	0,62/1	0,67/1	0,63/1	0,68/1
4	LLC «M.V. CARGO»	–	0,21/4	0,18/4	0,18/4	0,24 /4

Source: own calculations.

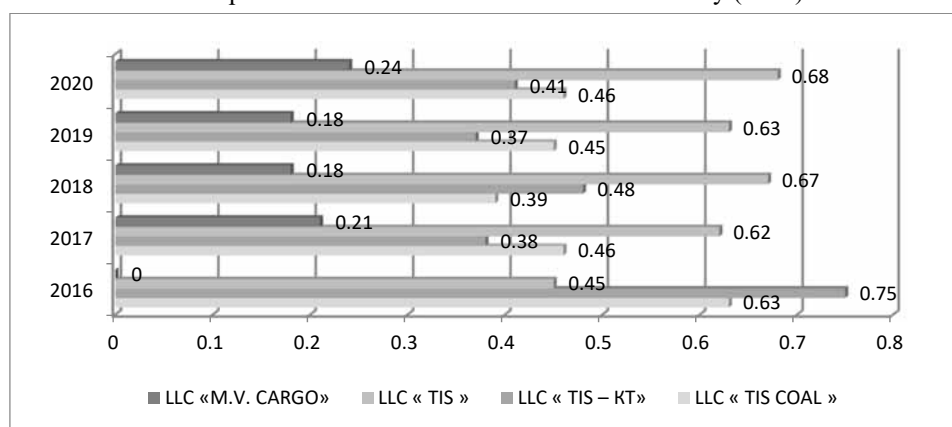
In order to visualise the value of the integrated indicator of the level of development assessment, we will construct a diagram that will reflect the trend of growth or decrease of the studied complex indicator during 2016-2020 for basic enterprises (Figure 6).

Analysing the value of the complex indicator, we conclude that in 2014 LLC «TIS-KT» had the greatest importance (0.75). In second place in terms of the value of the complex indicator in 2016 was LLC «TIS-COAL» (0.63), the smallest value was LLC «TIS» (0.45). In 2015, the situation changed very much: LLC «TIS» (0.62) took the leading position, LLC «TIS-COAL» (0.46) worsened its condition, LLC «TIS-KT» (0.38) occupied the third city, and the value of the complex indicator was halved. In 2018, the situation did not improve for all enterprises: the largest value of the complex indicator belonged to the company LLC «TIS» (0.67), LLC «TIS-COAL» reduced its position and the level of development compared to last year decreased (0.39), LLC «TIS-KT» took second place, and the value of the complex indicator was 0.48. In 2019-2020, LLC «TIS» had the largest value of the complex indicator

and amounted to 0.63 and 0.68, respectively. LLC «TIS-COAL» for two years left behind a second position with the value of a complex indicator at the level of 0,45-0,46. In third place in terms of the value of the complex indicator in 2019-2020 was LLC «TIS-KT» (0.37 and 0.41, respectively). For four years, the last positions have been held by LLC «M.V. CARGO».

Figure 6

Dynamics of the integrated indicator of assessment of the level of development of enterprises of Vizirska united territorial community (UTC)



Source: author's development.

To determine strategic guidelines for the development of production enterprises in the context of decentralisation, it is advisable to analyse for 2018 the results of a comprehensive assessment of economic, social, environmental and budgetary components of development, taking into account a system of indicators on the following aspects of development: market, production, financial and economic, innovative investment, social, environmental and budgetary (Table 4 and Figure 7).

Thus, based on the calculations and the scale of assessment of the level of development, we can conclude that LLC «TIS» has the highest level of development for all components, which allows it to implement a sustainable development strategy.

Table 4

Comprehensive indicators for assessing the level of development of Vizirska united territorial community (UTC) enterprises by development components for 2020

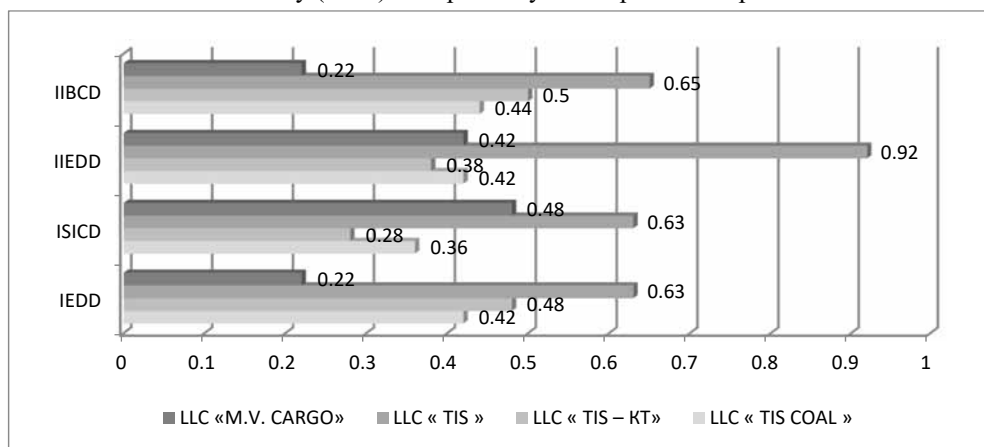
№	Enterprise	Integrated Economic Dimension of Development (IEDD)	Integrated social indicator component of development (ISICD)	Integrated indicator of the environmental dimension of development (IIEDD)	Integrated indicator of the budgetary component of development (IIBCD)
1	LLC «TIS COAL»	0,42	0,36	0,42	0,44
2	LLC «TIS – KT»	0,48	0,28	0,38	0,5
3	LLC «TIS»	0,63	0,63	0,92	0,65
4	LLC «M.V. CARGO»	0,22	0,48	0,42	0,22

Source: own calculations.

According to the scale of assessment of the level of development of a production enterprise, the economic, social and budgetary components of the development of LLC «TIS» are at an average level, but closer to the level of “normal development,” the environmental component is characterised by an “absolutely stable state.”

Figure 7

Comprehensive indicators for assessing the level of development of the Vizirska united territorial community (UTC) enterprises by development components for 2020



Source: author development.

According to the results of the study, comprehensive indicators of economic development, environmental sustainability and budgetary efficiency of LLC «TIS-COAL» and LLC «TIS-KT» in 2020 are at the level of unstable development, and the social component is in critical condition. In order to achieve the goals of sustainable development, enterprises need to pay attention to the quantitative goals of economic development, namely, to increase innovation and investment activity, and to make efforts to increase the level of social development.

LLC «M.V. CARGO» is at the lower level of development in 2020, and in terms of economic and budgetary components, it is in a completely critical condition, which is explained by the lack of profit at the enterprise. At the same time, at the enterprise, the goals of social development and environmental efficiency are achieved much better, social sustainability has the highest indicator.

The assessment of the selected directions of sustainability of the manufacturing enterprise with the subsequent access to determine the level of development carried out within the study allows to reasonably moving to the formation and implementation of its development strategy.

The assessment of the level of capacity of the Vizirian UTC in 2020 was carried out on the basic criteria that characterise the main socio-economic indicators that affect the development of the relevant capable territorial community (hereinafter – the criteria for assessing the level of capacity). Criteria for assessing the level of capacity are:

- population size, permanently residing in the territory of the capable territorial community;
- the number of students educating in general secondary education institutions located in the territory of the capable territorial community;
- the area of the land capable territorial community;
- index of fiscal capacity of the capable territorial community budget (coefficient that determines the level of tax capacity of the relevant local budget compared to the same average for all consolidated local budgets of Ukraine per capita);
- the share of local taxes and fees in capable territorial community budget revenues.

According to the Methodology of formation of capable territorial communities, approved by the Cabinet of Ministers of Ukraine, the estimated level of capacity of capable territorial communities is determined on the basis of the sum of numerical values of capacity assessment criteria and is: low level of capacity – from 1,5 to 2,1; middle level of capacity – from 2,2 to 3,8; high level of capacity – from 3,9 to 5.

Therefore, to ensure the development of both the Viziyan united territorial community and enterprises on its territory, there are all favourable conditions (Table 5).

Table 5

Financial capacity of Viziyan UTC in 2020 (forecast)

Evaluation criteria	Indicator	Numerical value	Capability level
Population size	7 508	1	high
Number of school-age children	903	1	high
Area, km ²	255,4	0,6	middle
Tax capacity index	6,48	1	high
Share of local taxes and fees	20%	0,6	middle
General level of capability		4,2 points	high

Source: authors calculations.

The assessment of the integrated nature of the impact of production development in the context of decentralised environment and growth of economic capacity of united territorial communities in Ukraine on the population's welfare is based on the expediency of deepening decentralisation and development of industrial enterprises to strengthen the economic capacity of territorial communities in Ukraine.

Using regression analysis tools for regional statistical data of Ukraine (Anatolii V. Usov, Liubov A. Niekrasova, Predrag V. Dašić, 2010) there was built econometric models (1) and (2) dependence of own incomes from one inhabitant of the united territorial community on private financially designed communities, and also with the participation of workers and volume of the realised products:

$$Y^{\wedge} = 2082,59 + 33,76X_1 + 2,19 X_2, \quad (1)$$

$$Y^{\wedge} = 2364,86 + 32,11X_1 + 1,47 X_3, \quad (2)$$

where:

Y^{\wedge} is the projected income of the general fund per capita of the UTC, UAN;

X_1 – share of financially capable communities, %;

X_2 – number of working employees, thousand people;

X_3 – volume of sold products, billion UAH.

The calculations showed a statistically significant impact of budget decentralisation and the development of productive business on the level of well-being of the population of the united territorial community. Therefore, firstly, the function of community development should be economic growth, which provides expanded reproduction of the economy of the territory.

Therefore, the territorial-industrial formation consolidates the resources of territorial public and industrial enterprises on the basis of common interests and goals of sustainable development, contributes to the formation of relations of social partnership between society, government and business.

Strengthening the independence of local authorities should stimulate and intensify economic activity, motivate the effective and rational use of existing capacity or management decisions to find alternatives and additional opportunities to increase the level of sustainable development of territorial production entities, by intensifying production activities to achieve the appropriate multiplier effect. economic growth and living standards

The developed scientific and methodological approach to modelling the system of management of the dynamic state of the production enterprise in the conditions of decentralisation provides for the formation of a model for the development of the production enterprise in cooperation with the UTC according to indicators of its development (Figure 8).

$$Y(t) = \int_0^t g(t-\tau)v_p(\tau)d\tau = g(t-\theta)\int_0^t v_p(\tau)d\tau = g(t-\theta) * Su, \quad (3)$$

Where:

$0 < \theta < t$; Su – component value $v_p(t)$ development resource.

X – vector-function of the production and processing process of the enterprise;

$\frac{dx}{dt}$ – operation of the production system;

V_{p2} – production control system;

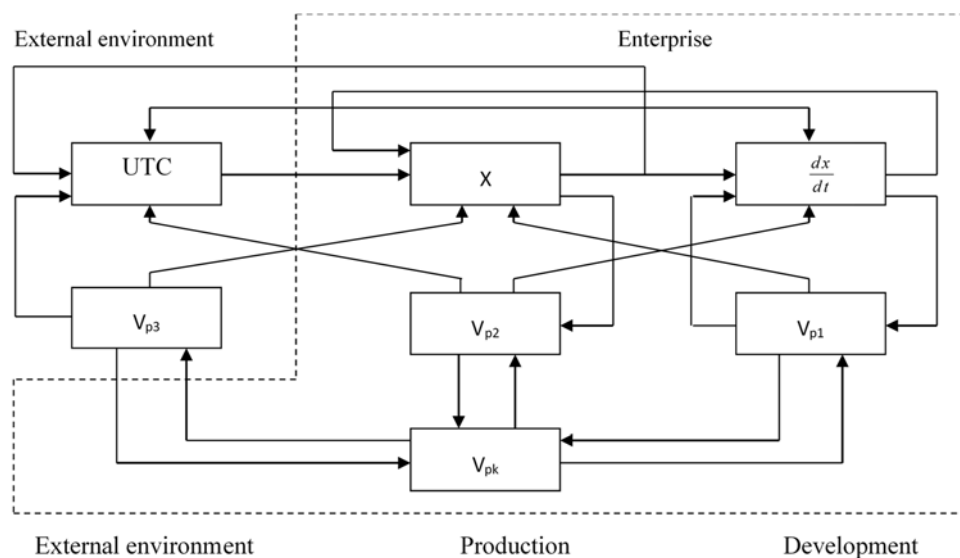
V_{p1} – development management system;

V_{p3} – control system of interaction with UTC;

V_{pk} – negotiation system, which provides interaction with UTC – $x(t) \frac{dx}{dt}$.

Figure 8

Structural diagram of the development model of the production enterprise in cooperation with the united territorial community (UTC)



The quantitative assessment of the sustainable development of the productive enterprise and territories is based on a set of measured indicators and indicators for regular monitoring of the situation, which makes it possible to identify the missing areas of monitoring that need to be monitored in order to achieve the overall goal of improving the level of sustainable development.

The concept of strategy for sustainable development of the enterprise in the context of decentralisation, its conceptual model, developed (Figure 2), is based on management decisions based on a set of targets formulated as a compromise between the achievement of the goals of the owners of the enterprise, standard financial and economic indicators and priorities of sustainable development of the enterprise, formulated taking into account the sectoral characteristics and sustainable development needs of a certain.

A model of management of the development of the production enterprise was built in the conditions of decentralisation for LLC «TIS», which is located on the territory of the Vizirska united territorial community (UTC) (4). Thus, an increase in the input characteristic of the share of advanced technologies by 17% leads to an increase in budget efficiency by 10%, the remaining efficiency in the Armed Forces for its development:

$$y_2^*(t) = \int_0^t \{ [0,278 + 0,163(t - \tau)]0,193 + [0,313 + 0,056(t - \tau)]0,23 \} d\tau = y_2(t) * 1,1 \quad (4)$$

Thus, it is advisable to carry out a comprehensive assessment of the level of development using economic, social, environmental and budgetary indicators at all enterprises of the united territorial community. It is this approach that will make it possible to realise your position both to enterprises and local authorities. The detailed analysis will determine the state of the enterprise on the market, adopt the experience of leading enterprises and calculate their capabilities to introduce effective development strategies considering the interests of the owners of enterprises, priorities for the long-term development of resource support, production and marketing, as well as the needs of the population of the territory and environmental protection.

Achieving their interests by each stakeholder – government, business, community, it is possible to provide conditions for regulating the interaction between them, employees and interaction, which as a result provide positive synergy effects for all parties:

- financial effects from the concentration of financial resources: increasing the financial efficiency of the page in the implementation of large projects, including infrastructure;
- economic effects: the benefits of the region and the state as a whole from the increase in tax revenues; from larger and higher-quality results of activity of large investors and contractors with the increased technical possibilities, productivity and quality of work involved under bigger volumes of financing; from combining technical, land, infrastructural capabilities; from the reduction of various risks of production activity and increase of probability of achievement of the planned result; from the effect of scale (savings on fixed costs);
- social effects: due to the implementation of joint large-scale social programs on a financial and economic basis, budget revenues have increased, as well as the joint use of the social infrastructure of the territories, which has led to improved quality of life;
- impact on the environment: due to increased resource opportunities for the implementation of pollution control programs;
- managerial and organisational effects, which are expressed in strengthening the relationship of coordination and interaction of municipalities, the implementation of management functions of local government;
- political effects, which are expressed in the increased level of trust of the population of territorial communities to local and central government;
- synergistic effects as a consequence of orderly interaction in large systems.

5. Conclusions

Application of the proposed scientific and methodological approach to the formation of a model of a system for managing the development of a production enterprise in the context of

decentralisation makes it possible to determine the dominant parameters of the development of production enterprises, which have an influence on OTG and timely tracking of pulses and spaces of OTG states considering the state of the Sun as parameters for its development. The results of the study are applicable for the development of systems for monitoring and strategic management of processes of development of production enterprises in the configuration of territorial-production entities.

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FUZZY LOGIC DECISION-MAKING MODEL FOR TECHNOLOGY FORESIGHT⁶

A new decision-making model in technology foresight based on fuzzy logic is proposed. The choice of technology as disruptive or critical doesn't depend on the subjective expert's opinion, but bases on the mathematically justified limits of technologies criticality. The basis of the model is the fuzzy inference system by Mamdani algorithm. Five of the most important criteria of criticality have been used as input linguistic variables. A new approach to defining membership functions based on equidistant derivative points is proposed and described in detail. The functioning of the model is considered by example. The influence of the application of different membership functions on the criticality assessment is shown. A comparison between the fuzzy model and classic expert model is also conducted.

Keywords: critical technologies; disruptive technologies; fuzzy logic; membership function determination; technology foresight

JEL: C30; C51; O20

1. Introduction

Forecast research in the technological sphere (technology foresight) is one of the most important tools for national economic development. By identifying key scientific and technological areas and ensuring their research, development and implementation, advanced

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countries have built successful economic models. The most promising areas in the technological field are called critical technologies (CT) by many countries (Sotnyk & Kupchyn, 2020).

In business theory, the last two decades have been increasingly talked about disruptive technologies that are revolutionary and destructive to the traditional system of the technological sphere. In 2020, even NATO's Science and Technology Organization published a report "Science & Technology Trends 2020-2040", which identified emerging and disruptive technologies (EDT) in the defense sphere (NATO Science & Technology Organization, 2020). The EDT list is quite closely correlated with the CT list, but it is much narrower.

The article aims to improve the prognostic study, which can be applied to both critical and disruptive technologies. Therefore, we will operate only with the concept of CT.

Foresight projects are usually based on expert assessments using the different methods (Wonglimpiyarat, 2006; Gavigan & Scapolo, 1999; Kovářiková et al., 2017; Calof et al., 2020). The result of technology foresight is the formation of a technologies list with certain criticality estimates. Research customers usually do not set the requirements for the concrete number of technologies to be included in the list of critical ones. It is obvious the technologies with the highest rating will be included in the list of CT and with the lowest – no. Only one question is open – "How can we determine the selection limit?" or "How many technologies should be in the critical technologies list?"

Usually, the final list of CT is determined by an expert council voting. However, these decisions based on subjective expert opinions are not always correct.

If there are no clear limits of technology selection, this issue can be solved quite successfully by using fuzzy logic. The authors propose a new model for determination the clarity limits, namely the mathematically justified limit of technology selection to the list of critical ones. This is what the article is about.

Today, the fuzzy logic is the basis for modelling various processes of almost all areas of human life, from household devices to navigation systems, artificial intelligence, robotic complexes and even illness diagnosis (Omrane et al., 2016; Govindaet et al., 2017; Jaafari et al., 2019).

The practical application of fuzzy logic always has a topical question about the definition of the membership function. In this article, the authors propose to determine the membership function not by experts, but by using of certain mathematical calculations.

There are a lot of scientific works, both domestic and foreign, that are majoring to the issues of technology foresight.

Thus, the publications (Paladchenko, et al., 2018; Gorbulin, et al., 2018; Romanowski, Nadolny, 2018; Gibson, et al., 2018). describe the main and most popular methods of foresight, such as Delphi, expert panels, bibliometric and patent analysis, SWOT-analysis, etc. The basis of forecasting is the use of a set of expert methods and Delphi is one of them (Gavigan, Scapolo, 1999; Wonglimpiyarat, 2006; Bühring, Liedtka, 2018; Dovhopolyi, et al., 2019; Calof, et al., 2020).

Issues in the field of CT development and implementation are considered by many scientists. In particular, the current situation for formation the CT list is shown in (Kupchyn, Sotnyk, 2019). The approaches to the definition of the concept of “critical technologies” and the process of CT list forming in different countries are described in the papers (Gibson, et al., 2018; Paladchenko, Molchanova, 2018).

At the same time, the fuzzy logic, used for a number of forecasting applied issues has become quite popular. The analysis of the application of fuzzy inference systems, artificial neural networks and adaptive neuro-fuzzy inference system for inventory control has been done in (Aengchuan, Phruksaphanrat, 2018). The results of research on the software fault prediction are described in (Erturk, Sezer, 2016) and the forecast of economic development and finance is given in (Hussain, et al., 2020). Fuzzy logic is used even to identify effective innovations in higher education (Jakeline, et al., 2017). And this is not a complete list of predictive researches using fuzzy logic.

However, it is not known for the article authors about the fuzzy logic application for technology foresight. Foresight projects to determine the disruptive or critical technologies, which are described in (Paladchenko, Molchanova, 2018; Gorbulin, et al., 2018; Romanowski, Nadolny, 2018; Bühring, Liedtka, 2018), are not fundamentally different from each other and just outdated. Modern business conditions create new types of risks and the need to find new mechanisms for management decisions (Britchenko, Kniazevych, 2015; Tkachenko, 2016; Baranovsky, et al., 2020; Danylkiv, et al., 2020; Pryshchepa, et al., 2020; Levchenko, et al., 2021; Ostapenko, et al., 2021; Polinkevych, et al., 2021; Dankiewicz, et al., 2021; Lu, et al., 2021; Volosovych, et al., 2021).

Intensive discussion in the scientific community about the expediency and necessity of CT development is sufficient clear evidence that the article issue is urgent.

The purpose of this paper is to determine the mathematically justified limits of technology criticality by the fuzzy logic using and design a decision-making model in the technology foresight.

2. Materials and Methods

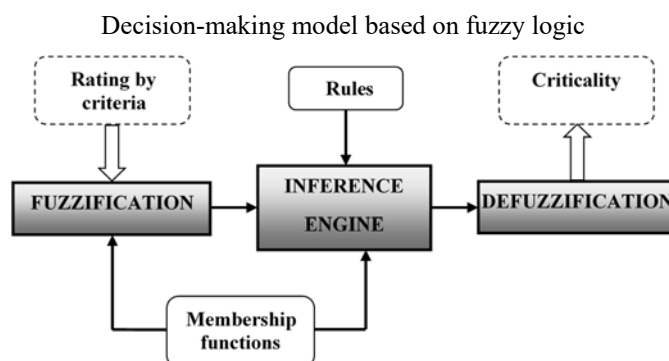
In early 2020, the authors of the article conducted an expert’s survey to determine the most important criteria for the critical technologies selection. The study identified five the most important criteria, namely: the scope of application, prospects, scientific and technical potential of enterprises, economic expediency and efficiency. A detailed description of the survey and its results is not given in this article; it will be published separately later.

According to the existing methodology, which is reflected in (Sotnyk, et al., 2020), the preliminary list of technologies is evaluated by an expert group. As a result, the list with the corresponding estimates by each criterion is formed. Next, the expert council decides which technologies will be considered as critical and which will not.

The authors of the article propose to eliminate subjectivity in decision-making by finding a mathematically justified minimal satisfactory level of criticality. To do this, it is proposed to

use a decision-making model applying fuzzy logic (Figure 1) (Shtovba, 2007; Feilong Liu, 2008; Yunlong, Zhirui, 2008; Kiran, Rajput, 2011; Xi, Byung-Jae, 2013).

Figure 1



Practically, the proposed model is a fuzzy inference system (FIS). The technology evaluations by criteria are given to the input. And the criticality of technologies is determined at the output.

The formation of a typical FIS includes the following steps (Yunlong, Zhirui, 2008; Feilong, 2008; Shtovba, 2007; Kiran, Rajput, 2011):

- I. Determination of membership functions for input and output linguistic variables;
- II. Rule base (knowledge base) formation;
- III. Determination of fuzzy inference algorithm (fuzzification, fuzzy inference, defuzzification).

Let's consider the proposed decision-making model by steps.

2.1. Determination of membership functions for input and output linguistic variables.

Usually, the definition of membership functions (MF) is entrusted to experts or based on the subjective researcher opinion (Leonenkov, 2005; Shtovba, 2007; Gonzalez, et al., 2014; Keshkar, Arzanpour, 2017; Kalantaievska, et al., 2018). This paper proposes a new principle of MF determination. The principle makes it possible to determine the limits of criticality based on mathematical calculations. The proposed solution to this problem consists of three steps.

2.1.1. Approximation of technologies distribution according to criticality estimates by criteria

We have generalised expert assessments for each criterion after receiving the expert survey results on determining the technology criticality.

For each technology, there are specific valuations of criticality by each criterion. After receiving these data, it is possible to conduct an approximation and find an approximate function that reflects the criticality assessment for each technology. If we place on the abscissa axis the technologies in ascending order of their criticality, we can get an approximate function that will be monotonically increasing.

During repeated calculations, the authors came to the conclusion that the most reliable approximate function is a polynomial function of the third and higher degree. The least-squares method, which will be used in this work, is the most common and effective for solving approximation issues (Mosayebidorcheh, et al., 2017; Dehghan, Mohammadi, 2017; Bota, Căruntu, 2017).

The authors propose to determine the minimal level of criticality by the approximate function of the criterion with the lowest weight coefficient, and the maximum – by the criterion with the highest weight coefficient. In this way, the maximum range of fuzziness will be ensured. It should be noted that the defined limits should be the same for all criteria.

2.1.2. Differentiation of the approximate function and finding the equidistant points

It's known, the geometric meaning of a derivative of a function is (Alekseeva et al., 2019, p.286):

$$f'(x) = \frac{\Delta y}{\Delta x} = \operatorname{tg} \alpha, \quad (1)$$

At the point, where the derivative of a function is equal to one, the function increment and the argument increment are equal. The name of this point is not a common concept, so the authors propose to introduce the term “equidistant point of derivative” (Huybrechs, 2009; Žlepalo, Jurkin, 2018).

If the approximate function is represented as a polynomial function of the third degree, then we will have two equidistant points (the derivative function will have a second degree, so the solution will have two values). This function can be represented by two versions, which are shown in Figure 2 and Figure 3.

For both cases $f_1(x)$ and $f_2(x)$ (figure 2, 3) we have two intervals of function changes. For $f_1(x)$ on the interval $x < x_1$ and $x > x_2$ the function increment increases much more than the argument increment, in contrast to other interval $x_1 < x < x_2$, where the function increment increases insignificantly in comparison with the argument. For $f_2(x)$ the situation is reversed, on the interval $x < x_1$ and $x > x_2$ the function increment increases much less than the argument increment, and on the interval $x_1 < x < x_2$ the function increment expands much more than the increase of the argument.

This means, it is no matter type of approximate function, the nature of its change will always have two intervals. This is the principle of determining the clarity limits (not fuzzy).

Remember, the abscissa is an ascending order technologies list of their criticality. It is logical to conclude that the technologies before point x_1 will have the lowest criticality, while the technologies after point x_2 – the highest. It is proposed to consider the interval between these

points as a fuzzy interval. Besides, it does not matter which approximate function is used, the first or the second type, because in the one function, the nature of its change will be different on these intervals.

It is offered the denotations:

- Clarity interval: $x \in (0; x_1) \cup (x_2; x_n)$;
- Fuzzy interval: $x \in (x_1; x_2)$.

Figure 2

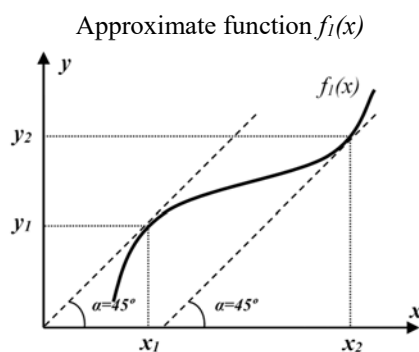
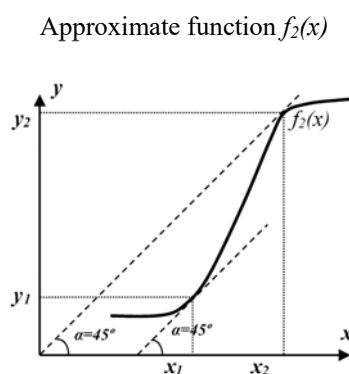


Figure 3



In terms of use, the fuzzy logic, these intervals form two fuzzy sets, which characterise the degree of technology criticality and are interesting for us:

1 – non-critical technologies set:

$$\mu(y)=1, \forall y \in (0; y_1) \text{ and } \mu(y)=0, \forall y \in (y_2; y_n),$$

2 – critical technologies set:

$$\mu(y)=0 \text{ for } \forall y \in (0; y_1) \text{ and } \mu(y)=1 \text{ for } \forall y \in (y_2; y_n),$$

$\mu(y)$ – membership function to a fuzzy set;

$y_1; y_2$ – values of the criticality at equidistant points;

y_n – maximum value of the criticality for studied technologies.

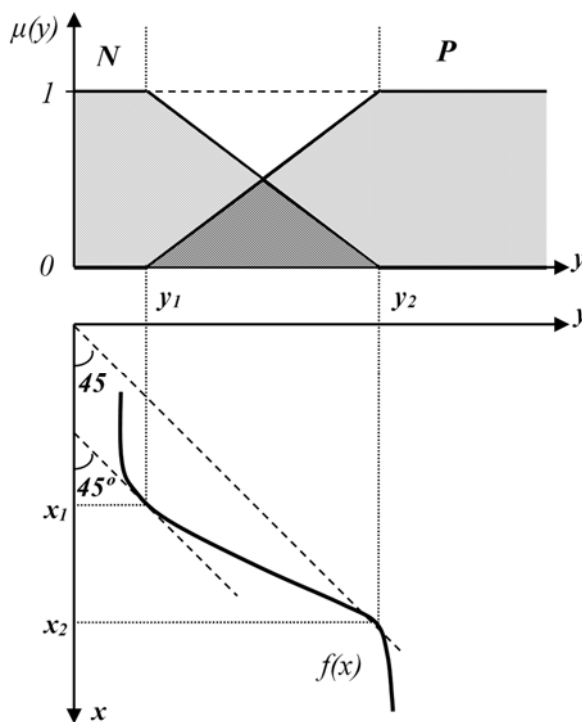
We find the values of y_1 and y_2 from the approximate function equation.

2.1.3. Determination of membership functions

Fuzzy sets theory does not oblige to choose the type of MF absolutely clearly or precisely (Leonkov, 2005, p. 64). It can be clarified in the research process based on the results of solving the task. The most common MF are triangular and trapezoidal, which will be used in the proposed model (Leonkov, 2005, p. 188; Shtovba, 2007, p. 19).

Figure 4

Membership function designing for a linguistic variable with the terms N and P



The predetermined intervals of fuzzy sets are the basis for the MF design of the input linguistic variables (LV). Having obtained equidistant points, we construct the corresponding MF (Figure 4). In this case, the point of the minimal value of the term N is the point of the maximal value of the term P and vice versa.

In the lower part of Figure 4, it is shown the approximate function $f(x)$ with equidistant points x_1, x_2 and the corresponding values of criticality y_1 and y_2 , according to a certain criterion.

The ordinate axis of the approximate function $f(x)$ is the abscissa axis for MF $\mu(y)$. The upper part of the figure 4 shows the MF for the two terms N and P (negative, positive).

The design of the MF for the output LV is different. It is also proposed to use the triangular and trapezoidal function, but with others points.

First, we need to determine the universal set of the output LV (β). Let's say that the maximum value of the output LV is equal to one, the minimum is equal to zero. In this case, the maximum mark on the criterion is equal to its weight coefficient.

It follows, that a certain technology will have $\beta=1$ if all criterion marks will have the maximum scores, and $\beta=0$ if criterion marks will be minimum. The maximum criticality of any technology is calculated as the sum of all criterion weights, and it is equal to 1. Next, it is necessary to determine the required satisfactory level of criticality.

Based on the first basic rule, which will be presented in the next chapter, the lowest satisfactory value of criticality is identically equal to the sum of two the most important weight coefficients of criteria:

$$\beta_{CR} = \omega_1 + \omega_2, \quad (2)$$

β_{CR} – the lowest satisfactory value of criticality;

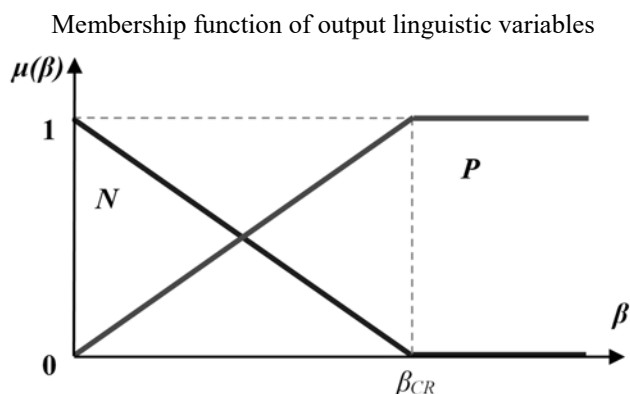
ω_1, ω_2 – weight coefficients of two the most important criteria.

Therefore, the MF of output LV (for the term "positive") will take the following values:

$$\mu(\beta) = \begin{cases} 1, & \beta \geq \beta_{CR} \\ 0, & \beta = 0 \end{cases}. \quad (3)$$

Accordingly, for the term “negative”, the MF will take inverse values (1 for $\beta=0$ and 0 for $\beta \geq \beta_{CR}$). Graphically, the MF of output LV is presented in Figure 5.

Figure 5



2.2. Rules base (knowledge base) forming

At first, we should determine the input, output LV and their term-sets, before the rules are formed. In our case, the input LV will be presented as all technology criticality criteria, and the output variable will be the criticality level. We use the common abbreviations for the convenience of term-sets writing. For example, for the term-set {"low", "medium", "high"} or {"small", "medium", "large"} it is better to use the common analogue {«N», «Z», «P»} (negative, zero, positive) (Leonenkov, 2005, p. 188).

There are shown the names of LV and their term-sets in Table 1.

Table 1

Linguistic variables of the fuzzy inference system

Input LV	Term-set for input LV		Output LV	Term-set for output LV	
α_1 – scope of application	«big», «small»	«P», «N»	β – criticality	«satisfactory», «unsatisfactory»	«P», «N»
α_2 – prospects	«significant», «insignificant»	«P», «N»			
α_3 – scientific and technical potential of enterprises	«enough», «not enough»	«P», «N»			
α_4 – economic expediency	«profitable», «unprofitable»	«P», «N»			
α_5 – efficiency	«high», «low»	«P», «N»			

The rule base is formed after the determination of input, output LV and their term-sets. The general view of each rule in the case of five inputs LV will be as follows:

«IF «Condition 1» AND «Condition 2» AND «Condition 3» AND «Condition 4» AND «Condition 5», THEN «Conclusion», where

«Condition 1» - the value α_1 is in the range of N or P;

«Condition 2» - the value α_2 is in the range of N or P;

«Condition 3» - the value α_3 is in the range of N or P;

«Condition 4» - the value α_4 is in the range of N or P;

«Condition 5» - the value α_5 is in the range of N or P;

«Conclusion» - the value β is in the range of N or P.

The maximum number of rules is calculated as all possible combinations of “Conditions” and in this case, is determined by the formula:

$$z = u^n, \tag{4}$$

z – number of rules,

u – number of terms for input LV,

n – number of input LV.

After calculations we obtained: $z=u^n=2^5=32$. It should be noted that formula (4) can be used only if the number of terms for each input LV is equal. In our case, we have 2 terms for each LV.

It is possible to reduce the number of rules if it is known certain information about the system. According to previous studies, there were obtained the weight coefficients of criteria for technology criticality. The results are listed in Table 2.

Table 2

Criteria for technology criticality

№	Criterion	Weight coefficient
1	Scope of application	0,14
2	Prospects	0,232
3	Scientific and technical potential of enterprises	0,175
4	Economic expediency	0,208
5	Efficiency	0,245

Experts identified after the survey that the most important criteria for technology selection are “prospects” and “efficiency”. Based on this, we can formulate the first two basic rules.

Rule 1: «IF «Prospects» of technology – significant and «Efficiency» – high, THEN «Criticality» – satisfactory ».

Rule 2: «IF «Prospects» of technology – insignificant and «Efficiency» – low, THEN «Criticality» – unsatisfactory ».

It does not matter which terms the other LV belong to, because only α_2 and α_5 have a key sense for conclusion forming.

The principle of other rules formulating will be as next. If three or more input LV belong to a positive (negative) term, then the output LV takes a positive (negative) term value. The proposed option contains 18 rules, which greatly simplifies the calculations.

However, the user does not have to do complex calculations if it is used the MATLAB program (Leonenkov, 2005; Shtovba, 2007; Chaira, Ray, 2009; Kyryk, 2019; Dadios, 2012). So for greater accuracy, we will use all 32 rules. The weight coefficients of the criteria have already been taken into account during expert assessment. So, the weights of the rules will be considered the same and equal to one. The estimates for each criterion are equilibrium. The formed base is systematically presented in Table 3.

Let we read, for example, rule 29, for a better understanding: IF «Scope of application – big» AND «Prospects – significant» AND «Scientific and technical potential – enough» AND «Economic expediency – unprofitable» AND «Efficiency – low», THEN «Criticality of technology – satisfactory».

Table 3

Rules base

Linguistic	Rules																																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32		
	Conformity to the terms																																	
α_1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	
α_2	N	N	N	N	N	N	N	N	P	P	P	P	P	P	P	N	N	N	N	N	N	N	N	N	N	P	P	P	P	P	P	P	P	
α_3	N	N	N	N	P	P	P	P	N	N	N	N	P	P	P	N	N	N	N	N	P	P	P	P	N	N	N	N	P	P	P	P		
α_4	N	N	P	P	N	N	P	P	N	N	P	P	N	N	P	P	N	N	P	P	N	N	P	P	N	N	P	P	N	N	P	N	P	
α_5	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
β	N	N	N	N	N	N	N	P	N	N	N	P	N	P	P	N	N	N	N	P	N	P	P	P	N	P	P	P	P	P	P	P	P	

2.3. Determination of fuzzy inference algorithm (fuzzification, fuzzy inference, defuzzification)

The Mamdani algorithm is the classic and most common (Leonenkov, 2005; Shtovba, 2007; Chaira, Ray, 2009; Dadios, 2012; Iancu, 2012; Kyryk, 2019), so it will be used in this work. The Sugeno algorithm, which is also presented in MATLAB, cannot be used in the proposed model, because the FIS output is a linear function or single set (Leonenkov, 2005; Hamam, Georganas, 2008; Srivastava, et al., 2018).

A concrete criticality value will be obtained for each technology, as a result of defuzzification. The technology will be critical if its criticality exceeds the required satisfactory level β_{CR} (calculated by (2)).

It is offered to consider the developed decision-making model as an example.

3. Results

During the technological foresight, an expert survey was conducted to determine the critical technologies list. Each of the 15 technologies was evaluated according to five criteria. Table 4 shows the generalised and already standardised estimates.

Table 4

Generalised estimates of technologies criticality

Criteria	Generalised and standardised estimates															The sum of evaluations by criterion
	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	
Scope of application	0,11	0,07	0,05	0,10	0,04	0,09	0,05	0,02	0,11	0,05	0,02	0,02	0,06	0,10	0,11	1,00
Prospects	0,06	0,08	0,10	0,09	0,03	0,04	0,06	0,09	0,05	0,11	0,04	0,08	0,10	0,06	0,03	1,00
Scientific and technical potential	0,10	0,07	0,06	0,05	0,10	0,07	0,04	0,07	0,11	0,10	0,09	0,05	0,06	0,01	0,02	1,00
Economic expediency	0,09	0,03	0,07	0,10	0,06	0,05	0,09	0,08	0,03	0,02	0,09	0,10	0,03	0,05	0,09	1,00
Efficiency	0,10	0,05	0,06	0,03	0,10	0,06	0,08	0,04	0,08	0,11	0,09	0,06	0,03	0,05	0,08	1,00

The weight for each criterion is known; Table 5 shows the survey results taking into account the criteria weights. In addition, for convenience, the results are multiplied by 1000.

Table 5

Generalised criticality estimates calculated with weight coefficients

Criteria	Generalised and standardised estimates calculated with weight coefficients															Weight coefficients (w*1000)
	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15	
Scope of application	15,39	10,26	6,84	13,68	5,13	11,97	6,84	3,42	15,39	6,84	3,42	3,42	8,55	13,68	15,39	140,260
Prospects	14,53	17,44	23,25	20,34	5,81	8,72	14,53	20,34	11,62	26,16	8,72	17,44	23,25	14,53	5,81	232,496
Scientific and technical potential	17,04	12,78	10,65	8,52	17,04	12,78	6,39	12,78	19,18	17,04	14,91	8,52	10,65	2,13	4,26	174,708
Economic expediency	19,11	7,17	14,33	21,50	11,94	9,55	19,11	16,72	7,17	4,78	19,11	21,50	7,17	9,55	19,11	207,810
Efficiency	24,47	12,24	15,30	6,12	24,47	15,30	18,35	9,18	18,35	27,53	21,41	15,30	6,12	12,24	18,35	244,726

After the results are obtained, we can design a fuzzy inference system.

3.1. Determination of membership functions for input and output linguistic variables.

First, it is necessary to obtain the criticality interval (crisp limits). The upper limit of criticality will be determined from the approximate function by the criterion “efficiency”, the lower limit – by the criterion “scale of application”. These criteria have the highest and lowest weight. Tables 6 and Table 7 show the criticality estimates for these criteria in ascending order.

Table 6

Distribution of technologies in ascending efficiency order

Ranked technologies list in ascending efficiency order															
Ranked numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Estimates	6,12	6,12	9,18	12,24	12,24	15,30	15,30	15,30	18,35	18,35	18,35	21,41	24,47	24,47	27,53
Real numbers of technologies	T 4	T 13	T 8	T 2	T 14	T 3	T 6	T 12	T 7	T 9	T 15	T 11	T 1	T 5	T 10

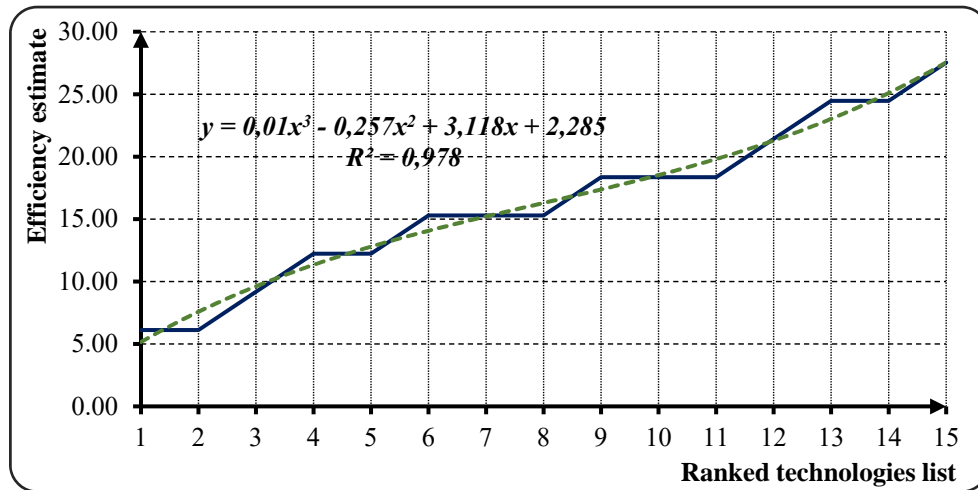
Table 7

Distribution of technologies in ascending scope order

Ranked technologies list in ascending scope order															
Ranked numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Estimates	3,42	3,42	3,42	5,13	6,84	6,84	6,84	8,55	10,26	11,97	13,68	13,68	15,39	15,39	15,39
Real numbers of technologies	T 8	T 11	T 12	T 5	T 3	T 7	T 10	T 13	T 2	T 6	T 4	T 14	T 1	T 9	T 15

Figure 6

Approximate function for criterion «Efficiency»



The graph of the technology efficiency growth is shown in Figure 6. After that, an approximation was conducted using the third-degree polynomial function.

The approximation was conducted by the least-squares method. The result is an approximate function with a trustiness of 98% (square of the correlation coefficient):

$$y = 0,01x^3 - 0,257x^2 + 3,118x + 2,285. \quad (5)$$

The next step is the differentiation. Then we equate the derivative to 1 and find the equidistant points:

$$y' = 0,03x^2 - 0,514x + 3,118. \quad (6)$$

$$y' = 1 \Leftrightarrow 0,03x^2 - 0,514x + 3,118 = 1 \Leftrightarrow \begin{cases} x_1 = 6,9 \\ x_2 = 10,2 \end{cases} \Leftrightarrow \begin{cases} y_1 = 14,85 \\ y_2 = 17,96 \end{cases}. \quad (7)$$

From (7) we choose the maximum value that will be the upper criticality limit (17,96).

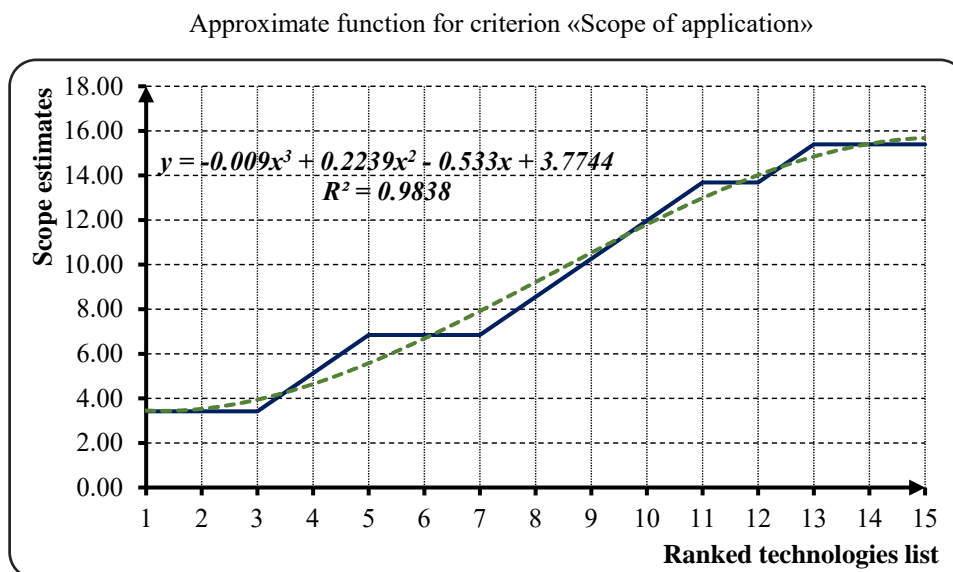
We calculate the lower criticality limit by a similar principle (Figure 7).

$$y = -0,009x^3 + 0,223x^2 - 0,533x + 3,774. \quad (8)$$

$$y' = -0,027x^2 + 0,446x - 0,533. \quad (9)$$

$$y' = 1 \Leftrightarrow -0,027x^2 + 0,446x - 0,533 = 1 \Leftrightarrow \begin{cases} x_1 = 4,89 \\ x_2 = 11,63 \end{cases} \Leftrightarrow \begin{cases} y_1 = 5,45 \\ y_2 = 13,58 \end{cases} \quad (10)$$

Figure 7

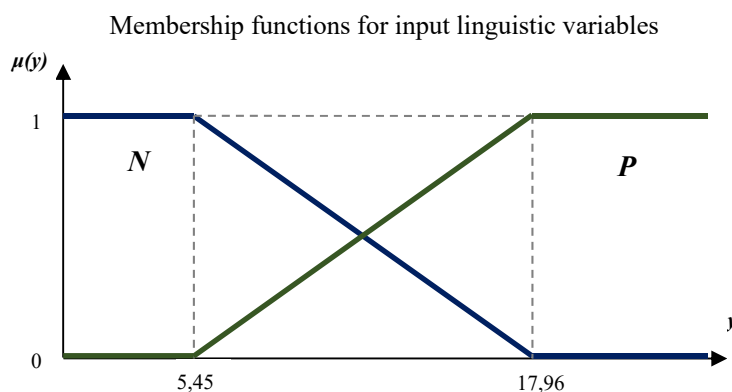


From (10) we choose the minimum value that will be the lower criticality limit (5,45).

Thus, we found the technology criticality limits that will be used for MF construction of input LV:

$$y_{\min} = 5,45; y_{\max} = 17,96. \quad (11)$$

Figure 8



To design the MF of the output LV, we should calculate the minimal satisfactory level of criticality β_{CR} by formula (2). The most important criteria are “prospects” and “efficiency”, their weights are presented in table 2.

The minimal satisfactory criticality level has the next value:

$$\beta_{CR} = \omega_2 + \omega_3 = 0,232 + 0,245 = 0,477. \quad (12)$$

Graphically, the MF of the output LV is presented in Figure 5.

3.2. Rule base (knowledge base) forming

Input, output LV and their term-sets were described in the theoretical part of the article and presented in Table 1. The rules were also formulated and presented in Table 3.

3.3. Application of the fuzzy inference system

3.3.1. Fuzzification

It is necessary to calculate the values of input MF for each term for each technology. The results of the calculations are shown in Table 8.

Table 8

Fuzzification results

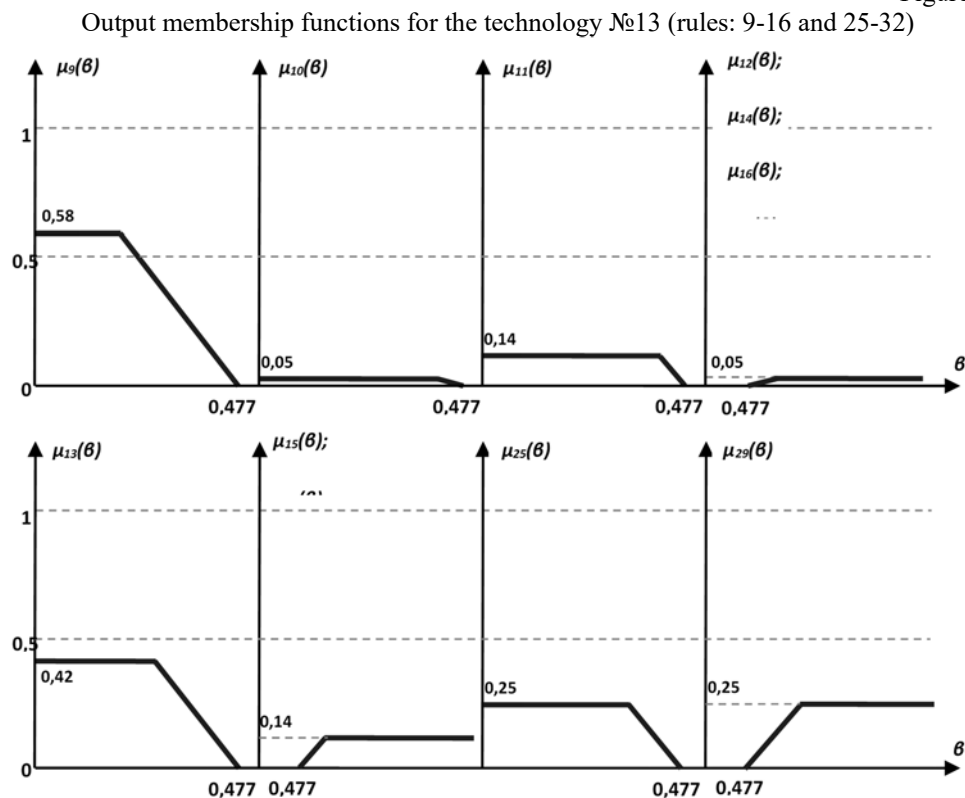
Input linguistic variables	Terms	Values of input membership function														
		T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14	T 15
Scope of application	P	0,79	0,38	0,11	0,66	0	0,52	0,11	0	0,79	0,11	0	0	0,25	0,66	0,79
	N	0,21	0,62	0,89	0,34	1	0,48	0,89	1	0,21	0,89	1	1	0,75	0,34	0,21
Prospects	P	0,73	0,96	1	1	0,03	0,26	0,73	1	0,49	1	0,26	0,96	1	0,73	0,03
	N	0,27	0,04	0	0	0,97	0,74	0,27	0	0,51	0	0,74	0,04	0	0,27	0,97
Scientific and technical potential	P	0,93	0,59	0,42	0,25	0,93	0,59	0,08	0,59	1	0,93	0,76	0,25	0,42	0	0
	N	0,07	0,41	0,58	0,75	0,07	0,41	0,92	0,41	0	0,07	0,24	0,75	0,58	1	1
Economic expediency	P	1	0,14	0,71	1	0,52	0,33	1	0,9	0,14	0	1	1	0,14	0,33	1
	N	0	0,86	0,29	0	0,48	0,67	0	0,1	0,86	1	0	0	0,86	0,67	0
Efficiency	P	1	0,54	0,79	0,05	1	0,79	1	0,3	1	1	1	0,79	0,05	0,54	1
	N	0	0,46	0,21	0,95	0	0,21	0	0,7	0	0	0	0,21	0,95	0,46	0

3.3.2. Fuzzy inference

Further calculations should be conducted using the MATLAB and with Mamdani algorithm.

As a clear example, it is offered to consider the technology № 13. In this case, rules 9-16 and 25-32 are applying. All rule weights are equal to 1, so the output MF is cut off to the “Conditions” truthiness degree. There are all the output MF in Figure 9.

Figure 9

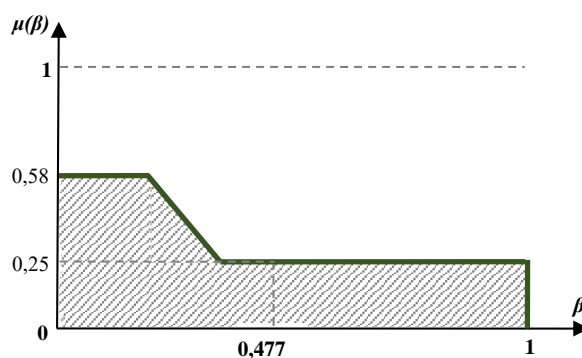


Fuzzy sets are joined by the “max” operation.

The obtained resulting output MF for the technology №13 is shown in Figure 10.

Figure 10

The resulting output membership function for the technology №13


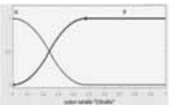




3.3.3. Defuzzification

The defuzzification results are shown in Table 9.

Table 9

Defuzzification results

Technologies No	Criticality assessments with the different types of membership functions for the output linguistic variables			
1.	0,581	0,591	0,698	0,704
2.	0,515	0,515	0,521	0,522
3.	0,547	0,55	0,583	0,585
4.	0,55	0,55	0,578	0,579
5.	0,507	0,507	0,509	0,509
6.	0,508	0,508	0,511	0,511
7.	0,566	0,567	0,611	0,614
8.	0,529	0,529	0,543	0,543
9.	0,547	0,555	0,604	0,606
10.	0,598	0,603	0,705	0,712
11.	0,571	0,573	0,624	0,627
12.	0,576	0,578	0,637	0,641
13.	0,401	0,402	0,396	0,398
13.	0,515	0,515	0,521	0,522
15.	0,58	0,582	0,644	0,648
View of MF	 criticality limit – 0,477	 criticality limit – 0,477	 criticality limit – 0,477	 criticality limit – 0,5

In the proposed example, only one technology is non-critical, because its criticality level is less than the limit 0,477. This is technology №13 (criticality level – 0,401). The other fourteen technologies are critical. The calculations of this example are shown in the first (painted) column of Table 9.

The authors decided to test how the change in the type of the output MF influences the result of the research. Both the calculated (0,477) and the classical (0,5) criticality limits were used. The general view of the output MF can be observed in the bottom row of Table 9 (trapezoidal, S-Z-shaped and rectangular).

The results of defuzzification with different types of MF are shown in Figure 11. The result of calculations has not essential changed when the different types of MF were used. In each of the four cases, the system showed almost identical results. The diagram clearly demonstrates that in the proposed example, the technology №13 is uncritical.

For comparison, in Figure 12 we can observe a diagram with summary estimates of technologies. These values are used in the existing method of forming the Critical Technologies List to create a rating of technologies. Based on the estimates, the expert council decides to include or not a certain technology in the list by voting. In contrast to the proposed in this paper fuzzy inference system, the rating principle of forming a List takes into account only generalised summary estimates of technologies. It is not taken into account

the minimal required satisfactory level of criticality or any rules which can be used in the best for the technology.

In the calculated example, the technology №14 has the lowest total summary estimates. Using the existing method, it would probably be decided to exclude the technology №14 from the list. But, table 8 shows that the technology №14 has satisfactory estimates by the three criteria, and the technology №13 has only one. Against this, the existing method looks absurd.

Clarity in this issue is given by the calculations using the other MF. The diagram in Figure 11 shows that the only correct solution is to exclude the technology №13 from the list.

If we are not talking about an example, but about real life, then miscalculations, even with one technology, can lead to millions of unjustified costs budget. And how many such miscalculations can be when the list includes several tens or even hundreds of technologies?!

Figure 11

Criticality assessment of the technologies using different membership functions

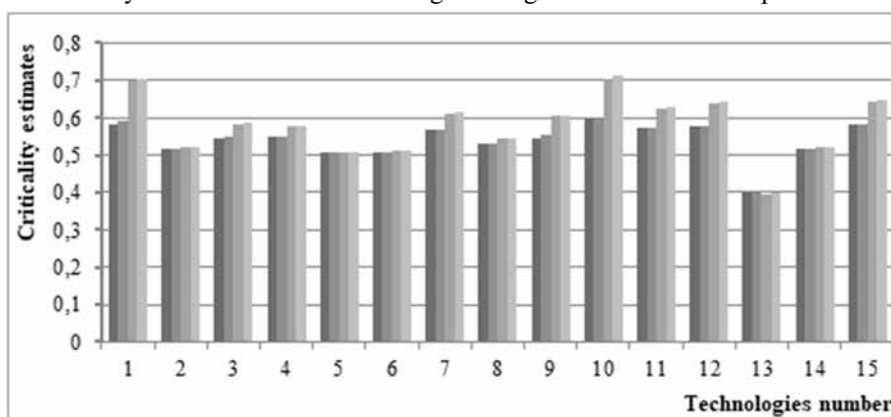
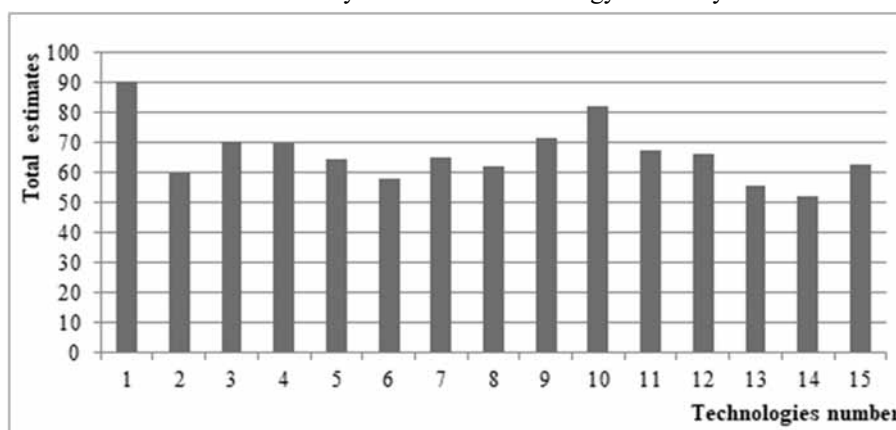


Figure 12

Total summary estimates of technology criticality



4. Conclusions

The proposed decision-making model makes it possible to quickly and efficiently generate a list of critical or disruptive technologies. It is possible to definite a clear line that determines the technology criticality, using fuzzy logic. Not only criterion evaluations are taken into account, but also minimally satisfactory criticality values, which are formulated as the fuzzy inference system rules.

The use of fuzzy logic in the technology foresight allows to remove the subjective expert error. This significantly reduces the time to make a decision, as it does not require an expert council meeting.

The authors propose a new way of finding a mathematically justified minimally satisfactory level of criticality. This makes it possible to determine the membership function based on mathematical calculations rather than the subjective opinion of the experts.

The analysis showed that the application of the model using fuzzy logic is much better than the decision-making model based on summary estimates.

All this makes it possible to prevent the technology forecast miscalculations and identify the most perspective technologies for their long-range development.

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ON THE ISSUE OF COMPLIANCE OF THE RESOURCING OF THE SECURITY AND DEFENCE SECTOR OF UKRAINE WITH THE CHARACTERISTICS OF THE SYSTEM⁵

The article summarizes the arguments and counterarguments in the scientific discussion on the development of a scientific problem for the creation of a modern concept of resourcing for the security and defence sector of Ukraine. The main purpose of the study is to analyze the category of “resourcing” to formulate the optimal scientifically grounded ways of further research. The systematization of literary sources and approaches to solving the problem of formulating the definition of “resourcing” has shown the presence of a wide range of scientific ideas and approaches to determining its content. The relevance of solving this scientific problem lies in the fact that the existing approaches to the resourcing of the defence needs of Ukraine require clarification and improvement. This is confirmed by the publication of several conceptual documents on ensuring the national security and defence of Ukraine. The study is structured in the following logical sequence: an analysis of approaches to determining the content of “resourcing” is carried out; the process of resourcing of the security and defence sector of Ukraine is analyzed for compliance with the characteristics that characterize the system. Methods of analysis, system analysis, and synthesis became the methodological tools of the study. The year from 1998 to the present was chosen as the study period for the content of the key definition. The object of the research is the resourcing of the security and defence sector of Ukraine. Since the ability to acquire the necessary capabilities by the components of the security and defence sector of Ukraine in the course of repelling armed aggression from the Russian Federation depends on the level of timely and full provision of defence needs. The study empirically confirms and theoretically proves the need for further research of the resourcing system as a subsystem of the security and defence sector of Ukraine of the national security system of Ukraine as a whole. The results of the study can be useful for scientists and managers, embracing the issues of comprehensively meeting the needs of the defence of Ukraine.

*Keywords: resources; resourcing system; security and defence sector of Ukraine
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Introduction

To restore its influence in Ukraine, the Russian Federation, continuing the hybrid war, systematically uses political, economic, information-psychological, cyber and military means. The groupings of the armed forces of the Russian Federation and their offensive potential are being strengthened. Large-scale military exercises are regularly held near the state border of Ukraine. This testifies to the persistence of the threat of a military invasion. The militarization of the territories of the temporarily occupied Autonomous Republic of Crimea and the city of Sevastopol is growing. The threat from the Russian Federation to free shipping in the Black and Azov Seas and the Kerch Strait remains.

Rapid technological changes, primarily in energy and biotechnology, developments in the field of artificial intelligence are significantly transforming the economy and society as a whole. The role of information technologies in all spheres of public life is growing rapidly. Weapon systems are being developed based on new physical principles, using quantum, information, space, hypersonic, biotechnologies, as well as technologies in the field of artificial intelligence, the creation of new materials, robotics and autonomous unmanned vehicles.

Taken together, the above will certainly affect the planning, organization and resourcing of the security and defence sector of Ukraine in the overall system of ensuring the national security of Ukraine.

The relevance of the topic is confirmed by the goals defined in the National Security Strategy of Ukraine and the Military Security Strategy of Ukraine.

The National Security Strategy of Ukraine (Decree of the President of Ukraine №392/2020, 2020) provides that Ukraine will strengthen the combat potential of the Armed Forces of Ukraine and other bodies of the defence forces by:

- Improvement and development based on modern technologies of management and logistics systems;
- Improving the material conditions of service for personnel;
- Equipping with new, in particular high-tech, models of weapons and military equipment.

The military security strategy (Decree of the President of Ukraine №121/2021, 2020) defines one of the main tasks – effective management in the field of defence, based on innovative solutions, modern business practices, program and project management of defence resources, improved processes for determining and meeting the needs of Ukraine’s defence.

In addition, the relevance of the topic of this study is confirmed by the publication of many conceptual documents aimed at the implementation of measures for the development and reform of the security and defence sector. It is determined based on the results of a comprehensive review of the security and defence sector of Ukraine. Reforms have begun following NATO norms, principles and standards. Resourcing of measures to improve the defence capability of Ukraine is becoming critically important for the success of the implementation of the solutions developed in the context of limited funding.

The purpose of the article is to analyze the category of “resourcing” and its compliance with the characteristics inherent in the system for further determination of the optimal scientifically grounded ways of further research.

Material and Methods

To achieve the goal of the study, its decomposition was carried out and partial tasks were determined:

- 1) Analyze the content of the “resourcing” category;
- 2) To analyze the correspondence of the category “resourcing” to the characteristics of the system.

During the research, the following methods of scientific knowledge were used:

- Analysis – during the study of the content of the category “resourcing”;
- Systematic approach – in the study of resourcing as a system;
- Synthesis, groupings – when concluding, comparing research elements.

Results and Discussion

1. In the academic explanatory dictionary (Institute of Linguistics of the Academy of Sciences of the USSR), the term “provision” means:

- 1) Provide action by value;
- 2) Material means of subsistence.

In terms of etymological content, “resource” (French Ressourse – auxiliary means) means the main elements of the production potential that the system has used to achieve specific goals of economic development (Ruus, Pike, Fernstrom, 2010).

In his scientific work on the study of the category “resource” Yu. M. Derevyanko notes that in this category it is necessary to understand any substance that, thanks to its energy-information potential, is capable of satisfying the needs of mankind (including any open stationary systems) (Derevyanko, 2009).

In scientific work on the problem of resourcing of enterprises in the rocket and space industry, Yu. B. Nadtochiy and L. I. Gorelova (Nadtochiy, Gorelova, 2019) understand resourcing as the totality of all types of resources (financial, labour, material, information, etc.), Purchased, produced (potential), or are available and rationally used in the production process.

According to L. T. Snitko, the resourcing of an organization’s activities is understood as a complex process of mobilization, accumulation, distribution, as well as planning, control, monitoring and other procedures aimed at efficient and rational use of resources and risk reduction in the organization’s activities (Snitko, 2004).

In scientific work on the resourcing of the national innovation system, S. V. Yurin (Yurin, 2010) gives the following definition of resourcing: “a set of internal and external resources and conditions necessary for the formation and sustainable functioning of the innovation sphere of the national economy”.

Exploring the system of resourcing as a component of economic security, V. Proskura notes that: “the management of the resourcing system for the economic security of the region is a purposeful impact on the region and economic relations arising in the process of formation, distribution and use of resources aimed at achieving and supporting the appropriate the level of economic security of the region and ensuring its sustainable development in order to ensure a high quality of life of the population in conditions” (Proskura, 2015, p. 196).

In her scientific work on the resourcing of the enterprise in modern economic conditions, N. Bogatskaya notes that the structure of resourcing for each organization is individual, based on the specifics of the industry in which it operates, the level of economic development, the state of development potential, the chosen strategy for further development (Bogatska, Shvets, 2007).

Exploring the resources of enterprises, M. I. Ivanov (Ivanov, et al., 1999) notes the broad sense of the process of resourcing in the formation of sources of enterprise activities and at the same time fully covers all elements of strategic management of activities as a whole.

Further, the approaches to the interpretation of the term “resourcing” in the context of industries were analyzed, in accordance with which the corresponding table was drawn up (Table 1).

Table 1

Content of the resourcing system

Year	Author	Field	Definition
1998	A. Zaruda (1998)	Banking	Monetary resources. Which form the basis of all types of active operations, the sale of products, services by commercial banks
2003	A. Melnik, O. Obolensky, A. Vasin, L. Gordienko (2003)	Governance	The set of resources that are used or can be used by an organization to carry out its activities
2008	M. Frantsuzova (French, M.A., 2008)	Organization management	The system of institutional elements required for the distribution and redistribution of resources by business entities
2009	T. Bezverkhnyuk (2009)	Governance	The system of state measures aimed at creating material, legal, institutional conditions for transforming the elements of the resource space into means of achieving goals
2009	A. Chernaya (Chorna, A., 2009)	Entrepreneurship	The process of finding, attracting and using various types of resources; a complex system, which includes a set of sequential, interrelated stages, methodologies, methods, models systematized with these tasks, make it possible to justify, choose a method of resourcing and evaluate the effectiveness of the chosen method
2009	O. Kremin (2009)	Entrepreneurship	A set of certain types of resources (material, technological, labour, financial, informational, intellectual) and sources of their formation, which are directly involved in the development of an enterprise or can be mobilized in order to ensure the large-scale use of its potential and the transition to a qualitatively new state

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Year	Author	Field	Definition
2009	K. Kuznetsova (2009)	Entrepreneurship	The ability of an enterprise to provide its activities with the necessary amount and a set of resources to achieve a positive economic effect at a certain point in time
2010	I. Sokovykh	Entrepreneurship	A set of resources available to an economic entity that can be included in the production process in various combinations, determined by technologies, taking into account predicted changes in business conditions
2010	S. Conceba	Production of products	A set of organizational and economic relations aimed at the optimal and timely attraction of appropriate stocks for the efficient production of goods or services
2013	W. Alkema, T. Pazeeva	Logistic activities	A set of measures for providing an enterprise with resources of the appropriate type and composition, including mechanisms for searching, receiving, storing, accumulating, planning, accounting, use and costs
2013	A. Piskunov	Agro-industrial sphere	Resourcing is a continuous process of ensuring the current production activities of the enterprise
2013	S. Tereshchenko	Agrarian business	A complex process of mobilization, accumulation, distribution of resources, as well as implementation of planning, control, monitoring and other procedures aimed at efficient and rational use of resources and risk reduction in the activities of the enterprise, especially since it is agricultural
2014	N. Vodopyanova	Psychological sciences	The process of forming the resource base of the subject for the implementation of professional activities
2014	O. Pozniak	Logistics	Is an activity carried out by a logistics provider in order to make optimal use of the available economic resources
2015	L. Khristenko	Entrepreneurship	The complex process of sequential, systemically related and coordinated logistic (search, mobilization, accumulation, distribution and use of resources) and management (forecasting, planning, control, monitoring, accounting, analysis, etc.) stages aimed at ensuring the effectiveness of results
2016	V. Dergacheva	Energy sphere	The ability of an enterprise to provide its activities with the necessary amount and a set of resources to achieve a positive economic effect at a certain point in time
2017	A. Maidanyk	Entrepreneurship	It is a system of institutional elements necessary for the distribution and redistribution of resources by business entities and their structural units, as well as the transformation of resources from one form to another
2020	Order of the MoD of Ukraine dated December 22, 2020 No. 484	Defence sphere	Provision of capability with the necessary weapons and military equipment, equipment, stocks of material and technical means and consumables, as well as financial resources
2020	A. Virabova	Health care sphere	Resourcing system
2020	M. Novozhilova	Sphere of civil protection	A structured set of necessary and available resources for performing the tasks of the daily mode of service and emergency mode, as well as a decision-making system for optimizing the structure of resourcing in the context of dynamic changes and challenges of the external environment

Source: developed by the author.

The analysis revealed the following key elements of the definitions proposed in Table 1 (Table 2):

Table 2

Key basis of the considered definitions of resourcing

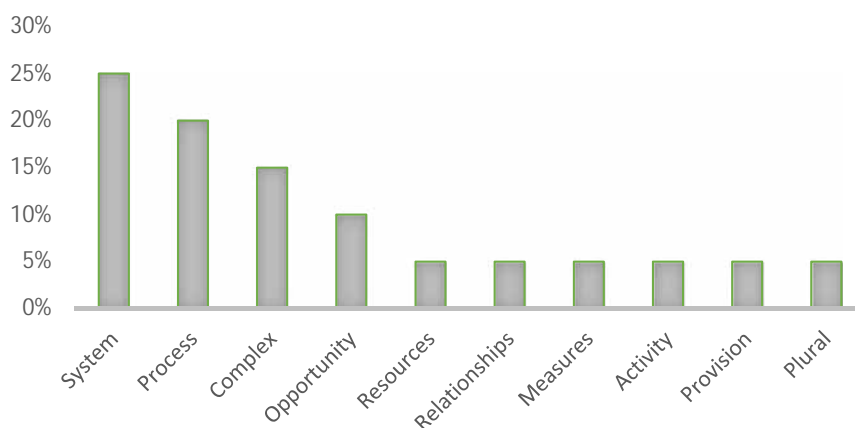
Year	Basis of definition	Keyword
1998	Monetary resources	Resources
2003	Complex of resources	Complex
2008	System of institutional elements	System
2009	System of state measures	System
2009	Complex system	System
2009	Complex of resources	Complex
2009	Opportunity	Opportunity
2010	Complex of resources	Complex
2010	Set of relationships	Relationships
2013	Continuous process	Process
2013	Complex process	Process
2013	Complex of measures	Measures
2014	Formation process	Process
2014	Logistics provider activities	Activity
2015	Complex process	Process
2016	Opportunity	Opportunity
2017	System of institutional elements	System
2020	Provision	Provision
2020	Structured set	Plural
2020	Resourcing system	System

Source: developed by the author.

The analysis of the key foundations of the definitions of resourcing discussed in Table 1 made it possible to single out the main idea (Figure 1).

Figure 1

Distribution of approaches to understanding resourcing



Source: developed by the author.

Taking into account the information presented in the table, you can see that the resourcing is understood as a system or process. If a process is “a sequential change of states or phenomena, which occurs in a regular order; the course of development of something”, then

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a system is “a collection of any elements, units, parts, united by a common feature, purpose” (Institute of Linguistics of the Academy of Sciences of the USSR, 1977).

Then, there is an urgent need to analyze the “resourcing” for compliance with the characteristics inherent in systems.

2. It should be noted that among scientists and managers, there is no unanimous understanding of the meaning of “resourcing” as a system. This is confirmed by the previously considered approaches to understanding the content of a subject definition. A system (from the Greek – a whole, made up of parts) is a properly ordered set of interconnected elements that form a certain integral unity among themselves (Alexandrova, 2005).

The main features of the system are integrity, presence of elements, interconnection and interdependence of system elements, interconnection with the environment, hierarchy, emergence, uniqueness, structure, and purposefulness.

Table 3

Analysis of compliance with the “resourcing system”

Property name (attributes)	Conformity thesis
Integrity	The integrity of the system is confirmed by the functional purpose of the elements, which lose their properties when leaving the system
Availability of elements	Functional elements (security forces; defence forces; military-industrial complex; citizens and public associations, structural units in the structure of the listed elements with a support function, decision-making nodes for resource provision, resource allocation nodes, resource accumulation and conservation nodes, resource circulation channels, entry/exit item, resource streams)
Interrelation and interdependence of system elements	The relationship of the elements is confirmed by a common goal (goals), the dependence of the acquisition of capabilities on available stocks, resource capacity and production capacity, supply and demand for military products, the interdependence of decision-making nodes, resource allocation
Relationship with the environment	The process of resourcing the security and defence sector is aimed at ensuring a system that, in turn, is a subsystem of the higher-order system – the system of national security of Ukraine. Existing relationship with the security environment under the influence of external and internal factors (natural/artificial)
Hierarchy	The presence of elements of a lower order depending on the level of decision-making (strategic, operational, tactical), the presence of subsystems of a lower order, the hierarchy of the organizational and staff structure, the hierarchy of resources, the functional separation of roles and responsibilities (the hierarchy of results, activities, resources)
Emergence	The synergistic effect of the constituent elements of the system allows you to achieve a unique goal due to the ownership of the elements of specific properties. Elements inherently separate do not have such a level of efficiency that is inherent in the system as a whole
Uniqueness	The main goal of the functioning of interconnected elements is generally not in obtaining commercial profits, but in acquiring certain capabilities by structural units (management system for the development of capabilities), the effective functioning of the system for the use of troops (forces) and the experience management system, social effect, but professional and motivated personnel, comprehensive prepared and provided with the necessary resources to perform the tasks as intended
Structure	Resource management entities, centres (nodes) for the accumulation and conservation of resources, structural units engaged in the development of resources
Sense of purpose	The system-forming factor of any functional system is the result on which the system works – the social effect, which is to ensure a sense of security by society through ensuring the necessary level of national security

Source: developed by the author.

According to the theory of research of control systems, a system is an integrated complex of interconnected elements with a specific unity of interconnected components and a specific unity with the external environment and, in turn, is a subsystem of a higher-order system (Alexandrova, 2005; Loishyn, 2019; Loishyn, 2019).

Taking into account the above and taking into account the content of the Law of Ukraine “On the National Security of Ukraine” – the security and defence sector is a system which, in turn, is a subsystem of a higher-order – the system of ensuring the national security of Ukraine.

Therefore, an analysis of the resourcing of the security and defence sector of Ukraine was carried out for the presence of signs and characteristics inherent in systems for further identification of internal and external factors of influence.

The resourcing of the security and defence sector of Ukraine is a system, as evidenced by the compliance with the characteristics presented to the system in the theory of systems control (Table 3).

It is possible to formulate a logical conclusion taking into account the provisions of the theory of the functioning of systems: if the components of the security and defence sector of Ukraine need to be provided with resources to maintain their functionality, and it is possible to confirm the facts of real such support. Then this will indicate the existence of a functional resourcing system.

Conclusions and Prospects of Further Research

The security and defence sector is a system, which, in turn, is a subsystem of a higher-order system – the system for ensuring the national security of Ukraine, and then the resourcing system for the security and defence sector of Ukraine is an appropriate subsystem.

First, the system to be investigated requires the determination of the types of resources used in the processes and circulate through its channels. Summarizing the analysis results, the approach to understanding the content and classification of resources in the security and defence sector system is very broad.

Therefore, the author considers at this stage of the research to understand the meaning of “resources” acceptable to determine the content of resources in the resourcing of the security and defence sector of Ukraine as everything that allows the object to form and implement its own strategies aimed at increasing economic and managerial efficiency, protecting values and interests in the process achieving a certain functional purpose of the goal.

A clear definition of the classification of resources in the resourcing system for the security and defence sector of Ukraine will be determined during subsequent studies following the formulated goals. This will be carried out in the development of a promising concept of resource support for the security and defence sector of Ukraine by building an appropriate model.

Prospects for further research are in the analysis of the provisions of economic theory, the theory of strategic management, the theory of public administration, the theory of military

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science for the availability of scientific provisions regarding resourcing in the process of strategic management.

Each system, in the course of its functioning, is exposed to the influence of external and internal factors that carry out a purposeful or indirect influence on the results of achieving the goal defined for the system.

It is proposed in the course of further research on the development of the concept of resourcing for the security and defence sector of Ukraine, to consider resourcing as a system and study it accordingly. Therefore, the confirmed consistency of resourcing requires an analysis of the influence of external and internal factors on the functioning of the resource provision system for the security and defence sector of Ukraine.

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CRAFT VILLAGE DEVELOPMENT AND ENVIRONMENTAL PROTECTION CHALLENGES IN THE RED RIVER DELTA OF VIETNAM²

This paper examines and assesses craft village development and challenges in the environmental management of craft villages in the Red River Delta region of Vietnam. This is the area where most of the craft villages of the country are concentrated. They contribute to creating jobs, increasing incomes for rural people, contributing to the successful implementation of the goal of hunger eradication and poverty reduction. However, this rapid development also creates many environmental consequences for rural areas. From the data published by state agencies and case studies in some craft villages in the Red River Delta, this article shows that economic development, rural urbanization create dynamism force for enterprises, households in craft villages to expand production, but also leads to fierce market competition between craft villages as well as environmental pollution. Although Vietnam has implemented many environmental protection policies, pollution in craft villages is still serious. Therefore, in order to ensure the handicraft village environment, research shows that it is necessary to promote supervision and monitoring of the implementation of environmental protection measures by businesses and households, in addition to building a policy of reasonably economic development for this area.

*Keywords: environmental pollution; Red River Delta; craft villages; enterprises
JEL: R11*

1. Introduction

The process of economic development and industrialization has been taking place in most countries around the world, causing certain impacts on the environment and public health. Since the implementation of the Doi Moi in Vietnam, in 1986 up to now, the rural craft villages have strongly developed in both quantity and scale. The Red River Delta region – where most of the craft villages of the country are concentrated – is also a region facing serious environmental pollution. In particular, the air and water pollution is complicated and

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has a big impact on the public health. The cause of this situation comes from the production and business activities of enterprises and households, transportation and domestic activities etc. Although being aware that the direct discharge into the environment violates the regulations, which can have a great impact on the environment and public health, many production households and businesses have no specific measures to reduce the amount of waste generated. This is a big challenge for state management agencies in craft villages. How to mobilize the participation and practical contributions of people and businesses to environmental protection is the key that helps craft villages to control pollution.

Currently, craft villages in Vietnam have many different concepts, which can be approached from a certain perspective, but can also be approached from many different perspectives or from the development model of the craft village. For example, from the perspective of administrative management, it is considered that a craft village is an ancient administrative unit. This is a place with a large population, organized activities, and has its own rules and customs in a broad sense (Pham Con Son, 2004: 9). From an economic perspective, author Duong Ba Phuong believes that a craft village is a rural village with one or several handicrafts separate from independent handicrafts and business activities. Income from these craft villages accounts for a high proportion of the total income value of the whole village (Duong Ba Phuong, 2001, p. 13). From a historical perspective, craft villages are said to be villages that formerly relied on agriculture. However, due to certain objective conditions such as favourable geographical location, secondary occupations with consumption markets on the regional and regional levels, they have switched to producing specialized handicraft products, but still not separate from agriculture. Craft villages have a team of professional or semi-professional artisans. They have a certain secret of making production. The items produced by artisans are aesthetically pleasing and have a large market for consumption (Truong Minh Hang, 2012). From a cultural perspective, a craft village is said to be a physical and mental entity that is geographically fixed, occupationally stable or a group of closely related occupations to produce a product, has a long history and is circulated in folklore (Le Thi Minh Ly, n.d). From the perspective of the general approach, the author Tran Minh Yen said that the craft village is a socio-economic institution in the countryside, constituted as a craft village element, existing in a certain geographical space. In which many households are mainly living by craft; there is a socio-economic and cultural link between them (Tran Minh Yen, 2004). Legally, according to Circular 116/2006/TT-BNN dated December 18, 2006, of the Ministry of Agriculture and Rural Development, a craft village is one or more residential clusters at the hamlet, phum, squirrel level or similar residential areas in a village or town where there are rural craft activities, producing one or more different types of products.

Thus, it can be generalized that a craft village is a form of organizing the daily life and production of the rural community, with the characteristic that the majority of residents in the village perform the same a certain type of occupational activity for a living, and thereby form the type of social structure characterized by that occupational activity. Craft villages are different from ordinary villages in Vietnam in that there is a concentration of craft production activities in the community in many different forms of production organization, with their own cultural and historical characteristics and most of them are recognized by the state.

Until now, research on craft villages and craft village development has mainly focused on traditional craft villages. For example, Pham Con Son' research in 2004 (Pham Con Son 2004) confirms that traditional craft villages in Vietnam were set up and developed along with historical development. Up to now, research on craft villages and craft village development has mainly focused on traditional craft villages. The main professions are handicraft, fine arts, ceramics, stone, and bronze casting.... They are presented to associate with the cultural and historical characteristics of the area by the author. The process of industrialization and modernization has a clear impact on the development of craft villages, causing many craft villages to be lost. This is showed in Duong Ba Phuong's research in 2011 (Duong Ba Phuong, 2011). Until the research of the group of authors, in which the editor was Truong Minh Hang in 2012 (Truong Minh, 2012), presented quite in detail the characteristics and development of each group of craft villages in Vietnam, including stone crafting; metalworking; woodworking; knitting profession; painting; pottery; weaving and embroidery; paper-making, horse-making; folk painting profession; other jobs. There are also relatively clear engravings on craft villages specializing in producing and trading famous products of the provinces. For example, Ha Nguyen author in 2016, presented quite clearly the traditional craft village in Hanoi such as, Bat Trang ceramics, gilded in Kieu Ky, papercraft villages in Tay Ho etc. therefrom; we can see the cultural beauty of the Hanoi people.

Craft village environmental issues are mentioned sporadically in separate studies. For example, Do Kim Chi research in 2005 (Dang Kim Chi, 2005) shows that the development of craft villages in Vietnam is spontaneous, without planning, with low production levels, and simple labour. Most craft villages have not paid attention to environmental management, pollution control, and waste treatment. The evidences for these claims are also mentioned quite clearly in the studies. Over time, the craft village has also had a new development, receiving more attention from the management agencies. This is mentioned in Do Viet Hung's study in 2017. The author has affirmed that the promotion of industrial-oriented trade village development, creating a large number of products, especially for new craft villages such as paper production villages, metal recycling villages etc., are causing serious environmental pollution. Meanwhile, the management of the government has revealed many limitations. A report by the Ministry of Natural Resources and Environment in 2018 mentions a number of water pollution problems in river basins in Vietnam, including some river basins that flow through craft villages.

The development of craft villages is not only considered in terms of quantity, but also the scale and quality of their development. Environmental problems arising directly from the production and business activities of households and enterprises in craft villages have been mentioned in a number of studies. However, their roles and responsibilities in environmental management and protection are not really respected. Most of the local management agencies are "doing by themselves" to carry out the environmental protection activities according to the guiding documents of the authorities. These are the contents that have not been mentioned, or very little mentioned in the previous works.

This paper analyzes and evaluates the development of craft villages in the Red River Delta region; the current situation of air and water environmental pollution; as well as the perception and action of private business leaders or, in other words, their role in protecting

the environment. Since then, the author gives recommendations to promote the role of business leaders in protecting the environment in this area.

This study is based on the actual survey results on production and business activities, perceptions and actions of business owners and individual business households in protecting the environment of craft villages in four provinces in the Red River Delta region. They include Hanoi, Bac Ninh and Hung Yen. These are the four provinces with a large number of craft villages and businesses in the Red River Delta region. At the same time, this research is also conducted according to data from reports of the Ministry of Natural Resources and Environment, People's Committees of provinces and cities and data collected from reports of Vietnam trade village associations.

The paper uses the results of the survey in 2019 and 2020 from 400 samples, surveyed in craft villages in four provinces of Hanoi, Bac Ninh, Vinh Phuc and Hung Yen. The groups of craft villages classified in this survey include: processing of household wood, fine-art wood; processing and preserving of agricultural and aquatic products; stone crafting; weaving, sewing, dyeing and embroidery; fine art pottery; wicker rattan and bamboo leaves; production and business of ornamental organisms; metal and non-metal recycling craft village. The questionnaire is designed in the style of a combination of structural and non-structured questionnaires to assess the level of awareness and behaviour of the surveyed subjects about the environmental issues of craft villages in the areas and to get their suggestions and wishes to solve the problems. Respondents will evaluate by their personal awareness of environmental issues in the craft villages where they live and do business.

Private enterprises, individual production and business households are subjects causing environmental pollution, mainly in craft villages. Leaders of private enterprises include business owners, representatives, business owners, people participating in the direct management and administration of production activities of private enterprises in craft villages. The head of an individual business household is usually the head of the household that applies for business registration.

2. The Development of Craft Villages in the Red River Delta Region

The increase in the number and size of craft villages is a very clear sign of the development of craft villages in Vietnam. The increasing number of craft villages could be newly formed craft villages, and possibly old craft villages restored, consolidated and developed. Increasing the scale of development means an increase in the number of labourers and the production scale of households and enterprises in the craft village. Since then, the volume of products and goods created by the craft villages has been increasing, creating a significant source of income for the craft villages, ensuring the lives of the people.

Regarding the number of craft villages, according to statistics in 2014, Vietnam has about 5,096 craft villages, 1,839 craft villages with all the criteria prescribed by the government etc. In which, there are over 2,000 traditional craft villages, with 53 craft groups, creating about 200 different types of handicraft products (Ministry of Natural Resources and Environment, 2015). By 2019, the number of craft villages is 5,400 trade villages. Products

of Vietnamese craft villages are plentiful, diversified, with beautiful designs and high quality. For example, silk from Van Phuc village, pottery of Bat Trang village, or silver carving in Dong Xam village etc. have been recognized as national brands. Although the products of many traditional craft villages have high economic value, Vietnam has not fully exploited their potentials (Ngoc Anh, 2019).

Many famous craft villages, which have been handed down and strongly developed up to now, for example, Bat Trang pottery village (Gia Lam, Hanoi); Cat Dang lacquer village (Y Yen, Nam Dinh); embroidery village (Van Lam, Hoa Lu, Ninh Binh); Dong Ho painting village (Thuan Thanh, Bac Ninh); Non Nuoc stone carving village (Ngu Hanh Son, Da Nang); Van Phuc silk village (Ha Dong, Hanoi); Cau Cao Nhan village (Thuy Nguyen, Hai Phong); My Dong casting village (Thuy Nguyen, Hai Phong); the puppet show Nhan Hoa (Vinh Bao, Hai Phong); the empty village of Lam Yen (Dai Loc, Quang Nam); Bau Truc Pottery Village (Ninh Thuan); My Nghiep brocade weaving village (Ninh Thuan) etc.

Besides, over time, some craft villages have been lost, and at the same time, new craft villages have emerged; there are craft villages that are steadily developing, but there are also craft villages that operate in moderation.

Table 1

Some lost craft villages in Hanoi

No.	Lost craft village	Product
1.	Dong My lacquer village	Lacquer
2.	Dai Ang conical hat village	Leaf cones
3.	Nghia Do honous paper	Honous paper
4.	Trieu Khuc sports festival	Sports festival
5.	Van Canh poonah-paper	Poonah-paper
6.	Ngu Xa copper casting	Copper casting
7.	Kim Hoang lacquer painting	Lacquer painting
8.	Dao Xa musical instruments	Musical instruments
9.	Lien Bat forge	Forge
10.	Hoa Xa texture	Texture
11.	Truong Thinh rattan and bamboo	Rattan and bamboo

Source: author compiled.

Not only Hanoi, but in our country, there were hundreds of craft villages that once prospered. Up to now, they have been lost like silk weaving, cocoon making, hewn, wooden clogs, painting, mosaic etc. There are many reasons for this situation. Such as, the craft village space is shrinking due to the rapid urbanization rate. The products of the craft village are no longer suitable with the development trend, no longer suitable for modern life, lack of applicability. Handicraft village products are subject to fierce competition between industrial products and product competition among craft villages. There is no next generation of craft village traditions etc. For example, Dong Ho painting village (Bac Ninh) with the age of >400 years still has very few families. Instead, they do other jobs. In some craft villages, artisans all their lives are crafting, crafting, rich in experience and skilful but unable to create new designs. Young people receive extra lessons in schools, dynamic, sensitive to the market, but lack of technical skills, professional skills, do not have a deep view of traditional values, like to follow the new generation, catch imitate etc. This is a major limitation for the product

development of the craft village. Production activities in the craft villages are fragmented, small, and lack of linkage. Brand promotion activities are still weak. Enterprises and products lack competitiveness in international markets etc.

Currently, the scale of craft villages is very different. From the perspective of production organization, most of the production and business establishments in the craft villages are organized in the form of individual business households, cooperatives, private enterprises, joint-stock companies, of which households do business individuals make up the largest proportion. The nature and scale of production of these types are very different. Individual business households can hire labour and mobilize loans for production. However, most of the individual households mainly use family labour, and at the same time, use their own capital to maintain production. As a result, production households have the advantage of being autonomous, flexible, and flexible in making use of their labour, leisure time and available facilities at home. However, these production households also have certain limitations in terms of relationships, legal status, and difficulties in technological innovation or signing labour contracts.

To further development, a number of craft villages appear some enterprises with large production scale, capable of replacing manual mechanization, and equipped with transport cars to transport raw goods. Therefore, the turnover of these enterprises is much larger than that of production households. However, most of these businesses are spontaneous, with little support from state agencies. Business owners in craft villages often start their own business, with little access to loans. Craft village enterprises often do not want to register their business to avoid management. Thus, the majority of production and business establishments in the craft village are small. Currently, there appear forms of production with like urban industrial production or concentrated industrial zones. They are companies, enterprises in rural areas. Up to now, the number of private enterprises in craft villages in the Red River Delta is approximately 3930 (Do Viet Hung, 2017).

Regarding the structure, the craft villages have developed the professional structure, which is also quite diversified and plentiful, suitable to the requirements of the domestic and foreign markets.

In terms of development space, craft villages are distributed mainly in the Red River Delta (accounting for about 60 percent), the Central region (about 30 percent) and the South (about 10 percent). The Red River Delta region includes 10 provinces and cities directly under the Central Government, which are the economic and cultural pillars in the North of Vietnam.³ This area is geographically located from latitude 21°34'N (Lap Thach district) to about 19°5'N (Kim Son district), from 105°17'E (Ba Vi district) to 107°7'E (on Cat Ba island), with an area of over 20,973 km², accounting for about 7 percent of the total area of the country. The North and Northeast borders the Northeast region of Vietnam, the West and Southwest borders the Northwest region of Vietnam, the East borders the Gulf of Tonkin, and the South borders the North Central region. The main river systems are dominated by the Red River and Thai Binh River, of which the Red River is the second largest river system in

³ From 2019 up to now, there are some statistics of Vietnam adding Quang Ninh province to the list of provinces and cities in the Red River Delta region, but this study does not include Quang Ninh, because it is a province in the Northeast region of Vietnam.

Vietnam. The Red River system originates from China to provide domestic and production water for the whole region. The water quality of this river varies according to season and region, but so far, in Vietnam, there have been no studies assessing trans-regional and cross-border pollution on this river system etc.

The Red River Delta is densely populated, with about 20 million people accounting for 22 percent of the country's total population. This is the leading region for economic development in the North, with a thriving infrastructure system including the system of roads, railways, river ports, sea etc. This creates a driving force for the connection, development and movement of the whole region with neighbouring regions such as the Northern key economic region, the capital region, the Northern Midlands and the Mountains region. In terms of the economic scale, the Red River Delta ranks second in the whole country, after the Southeast region, accounting for 35.8 percent of the country's GDP, nearly 34 percent in budget revenue, and approximately 35 percent of annual exports. The economic structure is inclined towards industry and services, but this is still the second largest food and food sector of the country. The GDP growth rate of the provinces in the region is quite high in recent years. In 2020, despite the Covid-19 epidemic, the growth rate of Hanoi is 3.98 percent, Vinh Phuc is 2.21 percent, Bac Ninh is 1.36 percent, Hai Duong is 2.10 percent, Hai Phong is 11.22 percent, Hung Yen is 6.13 percent, Thai Binh is 3.23 percent, Ha Nam is 7.02 percent, Nam Dinh is 5.05 percent, Ninh Binh is 6.35 percent (Thuy Long, 2021).

This is also the area with the most craft villages in the country, especially traditional craft villages, with a history of hundreds of years of establishment and development, such as ceramics (Hanoi, Hai Duong), silk, lacquer, bamboo and rattan (Hanoi), fine art wood (Hanoi, Bac Ninh) etc. There are approximately 1,336 craft villages in this area, creating jobs for about 1.2 million workers with an average income of 35-37 million Vietnam dong/person/year (Vuong Dinh Thanh, 2017). Products produced from craft villages, especially handicraft products are diversified and plentiful. They are created by the hands of fine artisans and craftsmen, passed down from generation to generation; even the secret of making production is accumulated through generations in the family. In addition to meeting the domestic market, export is considered the main consumption direction for handicraft village products. Export turnover in 2016 is estimated at over 500 million US dollars. The average growth rate of handicraft villages in the period of 2011-2016 is always 10-15 percent/year.

This can be explained by some reasons, as follows: First, craft villages are closely linked to the lives of rural people, attracting a large number of workforce, and are the main source of income for most families. In the Red River Delta region, communication handicraft is the oldest and most developed in the North (Pham Con Son, 2004). Second, this is an area with favourable conditions for raw materials, with both an abundant labour force and a large consumption market. Third, craft villages need little capital; have the ability to turn capital quickly; create many jobs and are usually done in peasant families during leisure time.

In terms of labour, division of labour: craft villages in rural Vietnam were formed and developed to create jobs for farmers during leisure time in rural areas. Gradually, the labour force is clearly assigned and specialized to meet the economic development needs of the country. Craft villages already have a relatively clear division of labour. Professionals in the

village live mainly on their income from that profession. They make up a sizable proportion of the total population of the village.

Table 2

Number of craft villages in some provinces and cities in the Red River Delta by province

Craft village	Ha Noi	Vinh Phuc	Bac Ninh	Hung Yen	Thai Binh	Nam Dinh	Hai Duong	Ninh Binh	Ha Nam	Hai Phong
Fine ceramics	3	1	2	0	1	0	2	2	3	2
Processing household wood, fine arts wood	47	12	11	4	19	9	13	1	8	4
Processing and preserving agricultural and aquatic products	50	0	4	10	22	6	13	4	8	10
Stone crafting	1	1	0	0	0	0	1	1	2	0
Mechanical, metal	12	1	1	0	7	3	5	0	1	0
Textile, garment, dyeing, embroidery	59	1	5	2	61	8	13	2	9	0
Leather shoes, leather tanning	11	0	0	1	0	0	4	0	0	0
Rattan and bamboo	105	4	5	9	114	6	11	4	8	6
Production and business of ornamental organisms	3	1	0	7	0	1	0	3	1	3
Recycle and treat waste	1	0	1	3	0	0	0	0	0	1
Iron, copper cast and inlaid metal	1	0	4	2	6	4	1	0	0	2
Others*	14	6	6	7	24	4	8	3	5	8
Total	307	27	39	45	254	41	71	20	45	36

* include craft villages in production of building materials; aquaculture of animals, aquatic and marine products; waterway transport; building; musical instrument producing; salt production; paper production, printing and copying of books, magazines, tapes; toys manufacturing; producing products from rubber, plastic; plant farming; medicine; producing incense

Source: Author's statistics.

For product structure: Currently, the product structure of craft villages is not flexible and innovative. Product structure: Currently, the product structure of craft villages is not flexible and innovative. According to survey data in 2016, about 72.5 percent of products are traditional, only 27.5 percent of products are new products. On average, a manufacturer in the craft village can create from 2.35 – 4.17 new product samples annually, of which 80-85 percent of samples ordered by customers or copied samples are available on the market (Vuong Dinh Thanh, 2017). Thus, it can be said that the ability of manufacturing establishments to develop product designs by themselves is still limited.

In order to meet the consumer demand of the domestic market as well as the foreign market, craft villages must diversify products while improving product quality, meeting quality requirements according to regulations. The product diversification can be done through the diversification of product categories, specifications, designs, prices etc. Traditional craft products need a combination of new and advanced production technologies and craftsman's skills and techniques. By doing this, the products of craft villages are able to compete in the domestic and international markets.

3. Environmental Management Challenges in Craft Villages in the Red River Delta

The challenge of environmental pollution

In fact, besides the social and economic issues, craft villages in the Red River Delta are facing many environmental challenges such as air, soil, water, noise pollution etc. This is a comment in the Socio-Economic Development Report, Annual Environmental Report of Red River Delta Provinces, and at the same time, these are also the issues raised in the questions for business households when conducting surveys in craft villages.

Table 3
Environmental challenges in craft villages in the Red River Delta region

Current environmental problems in craft villages	Total sample survey	The answer is "yes"		The answer is "no"	
		Amount	%	Amount	%
Air pollution	400	323	80.75	77	19.25
Water pollution	400	298	74.50	102	25.50
Soil pollution	400	156	39.00	244	61.00
Solid waste pollution	400	302	75.50	98	24.50
Contamination of nylon bags	400	265	66.25	135	33.75
Odor pollution	400	321	80.25	79	19.75
Noise pollution	400	120	30.00	280	70.00
Others	400	89	22.25	311	77.75

Note: The answer "yes" or "no" is the subjective, personal opinion of the respondent

Source: Author's survey data in 2020.

Survey results (Table 3) show that most of the surveyed subjects admitted that they have to face the challenge of environmental pollution, in which, air pollution (80.75 percent), odour pollution problem (80.25 percent), water pollution (74.50 percent) etc. These are problems, which arise directly in the production and business process of enterprises, production households in craft villages. This also shows a significant change in the perception of business leaders and production households on environmental issues in general in recent years. Before that, the prominent issues in the craft village included: income, employment, education etc. (Vo Thanh Danh, 2010).

Regarding to air pollution, in craft villages, especially wood processing and recycling villages in the Red River Delta, is taking place quite seriously (Amann et al., 2018, p. 20). The main exhaust gases include dust, SO₂, H₂S, CO, slightly alkaline, acid vapour, solvent vapour, etc. (Ministry of Natural Resources and Environment, 2017). General survey results in 2018 of Hanoi showed that 60/65 craft villages had environmental pollution, and only 6/65 craft villages met environmental safety standards. In terms of air pollution, there are 12 seriously polluted craft villages, mainly wood recycling and processing villages; 10 polluted craft villages; 43 craft villages are not polluted (Tong Minh, 2020). In 2019, the results of analyzing air samples in 228 craft villages showed that there were 12 seriously polluted craft villages, mainly villages of recycling and wood processing; 10 pollution villages (Hoang Son, 2020). In Vinh Phuc, the results of the survey and classification of craft village production establishments by type of production and potential for environmental pollution in 7 craft villages in Vinh Tuong district in 2015 showed that 2 carpentry villages belong to An Tuong commune is determined to be quite serious dust, smoke and noise pollution. They arise from

sawing, sawing, polishing and solvent vapor from painting. In Bac Ninh, the results of annual monitoring in Van Mon craft villages show that the concentration of SO₂ is 3.1 times higher than the permitted standard, the concentration of NO₂ is 2.2 to 2.6 higher than the standard times. Dust concentration in the craft villages is quite high and most of them exceed the permitted level by 1.1 – 1.8 times (Nguyen Cuong, 2016). In Phong Khe craft village, the analysis results of air samples showed that dust content exceeded the permitted standard from 2.05 to 2.14 times. The SO₂ content exceeded the permitted standard from 1.38 to 1.39 times. In Chau Khe, the dust content exceeds the permitted standard by 1.8 – 1.9 times, the SO₂ content exceeds the permitted standard by 1.4-2 times (Thu Van, 2020).

Survey results assess the level of air pollution for business leaders and business households in the Red River Delta craft villages also show that most of them are aware that air pollution is taking place quite seriously.

Table 4
Assessment of air pollution levels in craft villages in the Red River Delta region

Agreement level Issues	Number of respondents	Agreement level										Average point
		Disagreement		Irresolution		Agreement		Quite agreement		Very agreement		
		Number	%	Number	%	Number	%	Number	%	Number	%	
1. Currently, the environment of the craft village in the locality where you live and produce is polluted heavily	400	46 (46)	11.50	74 (158)	18.50	108 (324)	27.00	89 (356)	22.25	83 (415)	20.75	3.22
2. The atmosphere has a lot of suspended dust and pollutants	400	25 (25)	6.25	45 (90)	11.25	70 (210)	17.50	118 (472)	29.50	142 (710)	35.50	3.77
3. Odor pollution from exhaust gas and wastewater	400	60 (60)	15.00	51 (102)	12.75	78 (234)	19.50	108 (432)	27.00	103 (515)	25.75	3.36
4. Production noise is a concern	400	56 (56)	14.00	65 (130)	16.25	154 (462)	38.50	85 (340)	21.25	40 (200)	10.00	2.97

Note: Disagreement – 1 point; Irresolution – 2 point; Agreement – 3 point; Quite agreement – 4 point; Very agreement – 5 point.

(...) number of points

The average point = total number of points / total respondents

The answer on the level is the subjective and personal opinion of the respondent.

Source: Author's survey data in 2019-2020.

Thus, the results in Table 4 show that most of the business leaders agree to strongly agree with the assessment that “Currently, the environment of the craft village in the locality where you live and produce is polluted heavily”, with an average point of 3.22. In which, they said that the atmosphere of the craft village is full of suspended dust and pollutants, with an average point of 3.77; Odor pollution from exhaust gas and wastewater in craft villages has an average point of 3.36; Production noise is a concern with an average point of 2.97. As for odour and noise pollution, when people live in areas with unpleasant odours and noises, the

human will gradually “adapt” and often tend to “ignore” the smell, sound, giving so the rating point is lower than the remaining comments.

For water pollution: It occurs in most craft villages in the Red River Delta, especially in the processing agricultural products and recycling villages. The pollution level is quite serious in lakes, ponds and river basins that flow through the craft villages (Ministry of Natural Resources and Environment, 2017 p. 20). Pollution levels depend on hydrology, weather (pollution levels increase in the dry season) and the control of waste sources.

Pollution takes place mostly in organic pollution. Typical pollution parameters are BOD5, COD, TSS, total N, total P, and Coliform (Ministry of Natural Resources and Environment, 2017: 25). They all exceed the allowed standards. For example, in Phu Loc wine-making village (Hai Duong), all wastewater from nearly 200 wine-making businesses is discharged directly into a pond, then discharged into an irrigation canal, which flows across the village without any treatment. In Banh Da Tong Buong village (Hai Duong), wastewater after the production is not treated and is discharged directly to the general drainage system of the village. The monitoring results for the surface water environment of the Center for Environmental Monitoring and Analysis of Hai Duong province showed that the COD content exceeded 12-15 times, TSS exceeded 2-3 times, Coliform exceeded 11-19 times, Ammonium exceeds 12-16 times, and phosphate exceeds 26-31 times the permitted standard (Nguyen Cuong, 2016).

The source of air and water pollution at craft villages in the Red River Delta region comes mainly from the production stages that households and enterprises carry out; living activities of the people; industrial production, trade, service etc. For different groups of craft villages, the stage of air and water pollution is also different. For example, the wood processing craft village, the production stage that causes the most pollution is material handling, product processing; while in the recycling villages, the main stage of pollution is transporting, gathering and treating recycled waste (Do Viet Hung, 2017).

Survey results on sources of air and water pollution at craft villages in the Red River Delta are shown in Table 5.

Thus, the source of air and water pollution in the craft village comes from many different sources, of which from production activities in the craft village accounts for 67.63 percent of the selected samples; from traffic activities with 63.07 percent; living activities 53.94 percent; from industrial production 43.98 percent. This also shows that, in the craft village, water and air pollution are affected by many different sources at the same time. Assessing more specifically the pollution level of each source, the table above shows that the highest pollution level is from production with an average point of 3.51, followed by transport with an average point is 2.39, industrial activities and daily life activities have an average point of 2.05.

In addition, the challenge of air and water pollution is becoming more and more serious in the craft villages due to the factors on Table 6.

Table 5
Sources of air pollution in wood processing and recycling craft villages in the Red River Delta region

Source of pollution	Number of respondents	(%)	Pollution level										Average point
			Very little		Light		Moderate		Severe		Very severe		
			Number	%	Number	%	Number	%	Number	%	Number	%	
1. From craft village production	271	67.63	35 (35)	12.92	25 (50)	9.23	55 (165)	20.30	81 (324)	29.89	75 (375)	27.68	3.51
2. From the daily life activities	216	53.94	37 (37)	17.13	141 (282)	65.28	32 (96)	14.81	3 (12)	1.39	3 (15)	1.39	2.05
3. From agricultural production activities	8	2.07	2 (2)	25.00	3 (6)	37.50	3 (9)	37.50	0 (0)	0.00	0 (0)	0.00	2.05
4. From industrial production activities	176	43.98	78 (78)	44.32	37 (74)	21.02	41 (123)	23.30	15 (60)	8.52	5 (25)	2.84	2.05
5. From transport activities	252	63.07	38 (38)	15.08	100 (200)	39.68	98 (294)	38.89	8 (32)	3.17	8 (40)	3.17	2.39
6. From others	202	50.62	78 (78)	38.61	98 (196)	48.51	18 (54)	8.91	5 (20)	2.48	3 (15)	1.49	1.79

Note: Very little – 1 point; Light – 2 point; Moderate – 3 point; Severe – 4 point; Very severe – 5 point.

(...) number of points

The average point = total number of points / total respondents

The answer on the level is the subjective and personal opinion of the respondent.

Source: Author's survey data in 2019-2020.

The table above also shows that, there are four groups of causes that make air and water pollution more serious in the craft village, including: (1) increasing production and business of enterprises and households with an average point of 3.61 and the number of respondents from the level of agreement to very agreement accounting for 87.97 percent; (2) Lack of technology for collection and treatment, with the average point of 3.64 and the number of respondents from the level of agreement to very agreement accounting for 86.31 percent; (3) Lack of financial resources, with an average point of 3.62 and the number of respondents from agreement to a very agreement for 85.89 percent; (4) Increasing the people activities, with the average point of 3.32 and the number of respondents from the level of agreement to very agreement accounting for 81.33 percent.

Thus, it can be said that businesses and households at craft villages in the Red River Delta have correct awareness of the pollution situation, the cause of pollution, as well as the cause of the air and water pollution increasing in craft villages. This is an important basis to mobilize their participation in environmental protection activities in these villages in the future.

Table 6

Causes of environmental pollution in craft villages are getting more serious

Source of pollution	Number of respondents	%	Agreement level										Average point
			Disagreement		Irresolution		Agreement		Quite agreement		Very agreement		
			Number	%	Number	%	Number	%	Number	%	Number	%	
1. Increasing production and business of businesses and households	400	100	15 (15)	3.73	33 (66)	8.30	161 (483)	40.25	75 (300)	18.67	116 (580)	29.05	3.61
2. Increasing people activities	400	100	37 (37)	9.13	38 (76)	9.54	169 (507)	42.32	75 (300)	18.67	81 (405)	20.33	3.32
3. Lack of awareness of households and businesses	400	100	81 (81)	20.33	81 (162)	20.33	83 (249)	20.75	83 (332)	20.75	71 (355)	17.84	2.95
4. Lack of sanctions, management regulations	400	100	73 (73)	18.26	76 (152)	19.09	81 (243)	20.33	81 (324)	20.33	88 (440)	21.99	3.09
5. Lack of technology for collection and treatment	400	100	23 (23)	5.81	32 (64)	7.88	138 (414)	34.44	80 (320)	19.92	128 (640)	31.95	3.64
6. Lack of financial resources	400	100	27 (27)	6.64	30 (60)	7.47	105 (315)	26.14	148 (592)	36.93	91 (455)	22.82	3.62
7. Lack of individuals and organizations leading	400	100	86 (86)	21.58	76 (152)	19.09	78 (234)	19.50	63 (252)	15.77	96 (480)	24.07	3.02

Note: Disagreement - 1 point; Irresolution - 2 point; Agreement - 3 point; Quite agreement – 4 point; Very agreement - 5 point.

(...) number of points

The average point = total number of points / total respondents

The answer on the level is the subjective and personal opinion of the respondent.

Source: Author's survey data in 2019-2020.

Challenges in creating and implementing environmental management measures

Regarding the creation of environmental management measures

In recent years, Vietnam has developed a number of specific policies and laws on environmental protection in general, but specific policies related to the environmental protection of handicraft villages seem to be lacking or mainstreamed into other policies. For example, the environmental management policy for the river flowing craft villages in the Red River Delta region is integrated into the water resource use management plan in the Nhue and Day river basins in 2015 and a vision to 2020; integration into provincial water resources planning.

Besides, legal documents regulating environmental management activities in craft villages are incorporated into other documents. For example, regulations on the management and control of pollution and degradation of river water resources in the craft village area were incorporated into the “decree on river basin management” in 2008, integrated into the revised Law on Water Resources⁴.

Environmental criteria are integrated into the regulations on consideration and recognition of craft villages according to Circular No. 31/2016 / TT-BTNMT, dated October 14, 2016, of the Ministry of Natural Resources and Environment. Regulations on environmental protection are only approved at the “project” level, namely, Decision No. 577 / QD-TTG in 2013, the master project on environmental protection for craft villages up to 2020 and orientations to 2030. Some localities such as Hanoi and Bac Ninh are still in the stage of building regulations on environmental protection. Vietnam still lacks specific regulations on the agency responsible for collecting the environmental protection fees wastewater, and waste emissions in the region. There are no legal documents specifically for the protection of the handicraft village environment according to the characteristics of each type of production etc.

Currently, some documents are available, but the regulations are not appropriate. For example, according to the current regulations, every business and production entity must prepare an environmental impact assessment report or commit to protect the environment or prepare an environmental protection project, but until now, most of the production households in the craft villages do not practice for many different reasons. In fact, this content is very difficult to apply to specific craft villages. Therefore, it is necessary to study and issue a form of commitment to environmental protection with simpler, more compact content.

On the other hand, regulations on gas and wastewater emissions, in general, are generally introduced for craft villages. If these standards are applied to the craft villages, it is still too high. Therefore, the production facilities in the craft village are all household-scale; there are no conditions and money to install the system of environmental treatment equipment, which meets current standards. Although the guiding documents for the implementation of the Law on Environmental Protection have been built a lot, but still do not fully take into account specific and objective factors for trade villages, the effectiveness and effectiveness of some documents are still low.

In craft villages, businesses, production and business households have not developed regulations on the protection of the air and water environment; they have only developed general hygiene regulations to limit waste discharge indiscriminately. This is a weakness, which businesses and production households need to overcome in the future.

⁴ For service and production facilities in craft villages, the Law also clearly stipulates that craft villages must have wastewater collection and treatment systems suitable to the scale of wastewater discharge and the ability of receiving wastewater of water source and be certified by a competent state management agency on water resources before submitting it for approval (Article 37) and restrict exploitation of underground water in craft village areas that have centralized water supply systems and water services to ensure quality requirements (Article 52).

Regarding the implementation of environmental management measures

The implementation of measures to manage and protect the environment in craft villages includes: implementation of policies and legal documents; investigation and assessment of the water and air environment; law dissemination, community awareness-raising; implementing environmental planning and projects; organizing the state management apparatus on environmental protection in general, the air and water environment in particular; inspection and supervision etc. They are still very limited.

For example, there are a number of regulations on environmental protection for craft villages, as mentioned above, but compliance with the regulations has hardly been implemented. The local government also ignores environmental issues and attaches importance to economic development. Although people and enterprises in the craft village are fully aware, they are still intentionally violating them for their own interests.

The implementation of the inspection and examination of the observance of the law on the protection of the handicraft village environment is carried out quite seriously in the provinces. Therefore, the management agency has discovered and sanctioned many cases of environmental pollution in general, including air and water pollution. The table below illustrates some specific contents:

Table 7

Sanction for administrative violations of environmental protection in some provinces in the Red River Delta region

No.	Province	Number of units are sanctioned	Amount (billion Vietnam dong)	Year
1	Hung Yen	83	6,7	2013-2018
		77	2,8	2019
2	Bac Ninh	156	6,8	2016-2018
3	Ha Noi	25		2010-2015

Source: Pham Ha, 2019; Nguyen Dai Dong, 2019; Doan Thanh, 2020.

In Hung Yen, from 2013 to 2018, management agencies have inspected and examined the observance of the law on environmental protection in more than 300 production facilities, detecting and sanctioning 83 units for environmental violations with the total amount of 6.7 billion VND. In 2019, 97 cases of environmental violations were discovered, of which 77 cases were sanctioned, with more than 2.8 billion VND etc. (Pham Ha, 2019).

In Bac Ninh, the Provincial People's Committee has set up a quick response team to deal with environmental pollution issues in the province. The province also strengthened the inspection and examination, and at the same time, they resolutely dealt with strictly production establishments that violated the law on environmental protection etc. In the 2016-2018 period, the Department of Natural Resources and Environment, the Management Board of industrial zones and the environmental police force conducted a planned inspection and unexpected inspection of the observance of the law on environmental protection for 518 production establishments in the province. Through inspection, they discovered and sanctioned administrative violations for 106 facilities, with a total fine of 3,771 billion VND, mainly small and medium production units in craft villages. In addition, districts, towns and cities also unexpectedly checked 403 facilities, detected and sanctioned administrative

violations for 50 facilities, with a total fine of nearly 3 billion VND (Nguyen Dai Dong, 2019). In 2016 and 2017, Bac Ninh province established an interdisciplinary inspection team, conducting a comprehensive inspection of 60 manufacturing facilities in Phong Khe 1 industrial zone and 32 manufacturing facilities in Phu Lam industrial zone. As a result, 28 production facilities were sanctioned for administrative violations with a total fine of over 5 billion VND (Nguyen Dai Dong, 2019).

Strictly control and monitor environmental pollution through automatic monitoring. For example, large waste discharging units, having wastewater generated over 100 m³ per day and night, must install automatic wastewater monitoring. In 2017, Hanoi carried out monitoring every two times per month for 28 large waste generating facilities; in 2018, monitoring was carried out once a month for five facilities, two times per month for 13 facilities and three times per month for 10 facilities. Thereby, it was discovered that 50 in 209 times of wastewater discharge exceeded environmental standards, requiring facilities to take measures and treatment. At the same time, the management agency also requires 37 facilities to install and operate the wastewater monitoring station automatically and continuously, a facility that installed an automatic emissions monitoring station.

The craft villages have been investigated and assessed by the local management agency on the air and water environment. However, this assessment is not conducted regularly and periodically. Even the assessments only focus on some craft villages that are experiencing serious environmental pollution, reflected by the media and local residents.

Environmental management is integrated into the general management function, so the task of environmental protection is inevitable to be secondary compared with the socio-economic development goals.

The planning of industrial zones and clusters for craft villages are only done in the power supply. The internal traffic system is sketchy, most of them have no regulations on environmental protection, there is no centralized wastewater treatment system and gas treatment system etc., that meet standards.

The reason for this situation is the lack of clear delineation of roles and responsibilities in protecting the environment of handicraft villages among ministries, as well among ministries and localities. Staff in charge of environmental management and protection in general, water and air environment management and protection in particular at all levels are too thin in number and limited in qualifications. There is a lack of investment capital for technology innovation, construction of wastewater treatment facilities, and exhaust gas from craft villages, etc.

Evaluation of the implementation level of environmental management and protection measures is shown in the table below:

Table 8

Evaluation of the implementation level of environmental protection activities in the Red River Delta region

Environmental management and protection activities	Number of respondents	%	Agreement level										Average point
			Very bad		Bad		Normal		Good		Very good		
			Number	%	Number	%	Number	%	Number	%	Number	%	
1. Having an environmental protection license from the regulatory agency	400	100	53 (53)	13.28	196 (392)	48.96	101 (303)	25.31	32 (128)	7.88	18 (90)	4.56	2.41
2. Fully fulfilling the obligations of environmental protection tax and fees in accordance with regulations	400	100	76 (76)	19.09	71 (142)	17.84	156 (468)	39.00	53 (212)	13.28	43 (215)	10.79	2.79
3. There are separate regulations on environmental protection	400	100	78 (78)	19.50	83 (166)	20.75	123 (369)	30.71	53 (212)	13.28	63 (315)	15.77	2.85
4. Energy usage level	400	100	80 (80)	19.92	90 (180)	22.41	65 (195)	16.18	81 (324)	20.33	85 (425)	21.16	3.00
5. Finding ways to save raw materials and input materials	400	100	15 (15)	3.73	27 (54)	6.64	123 (369)	30.71	153 (612)	38.17	83 (415)	20.75	3.66
6. Investing in advanced, modern and environmentally friendly technologies, reducing emissions at the stages where machines can be used	400	100	73 (73)	18.26	75 (150)	18.67	156 (468)	39.00	56 (224)	14.11	40 (200)	9.96	2.79
7. Building programs to reduce emissions and wastewater	400	100	51 (51)	12.86	148 (296)	36.93	153 (459)	38.17	23 (92)	5.81	25 (125)	6.22	2.56
8. Covering vehicles which carry goods and raw materials	400	100	46 (46)	11.62	68 (136)	17.01	133 (399)	33.20	71 (284)	17.84	81 (405)	20.33	3.18
9. Technology for recovering and treating waste gas and wastewater	400	100	98 (98)	24.48	179 (358)	44.81	88 (264)	21.99	28 (112)	7.05	8 (40)	2.07	2.19
10. Organizing communication, education and training activities on environmental protection for employees	400	100	50 (50)	12.45	63 (126)	15.77	138 (414)	34.44	61 (244)	15.35	88 (440)	21.99	3.19
11. Consulting with local communities and stakeholders on environmental issues of businesses and household businesses	400	100	53 (53)	13.28	53 (106)	13.28	146 (438)	36.51	63 (252)	15.77	85 (425)	21.16	3.18

Note: Very bad – 1 point; Bad – 2 point; Normal – 3 point; Good – 4 point; Very good – 5 point. (...) number of points

The average point = total number of points / total respondents

The answer on the level is the subjective and personal opinion of the respondent.

Source: Author's survey data in 2019-2020.

Table 8 shows that enterprises and individual household businesses in the craft villages have different assessments of the degree of implementing some measures to protect the air and water environment in the craft villages that they do. Specifically, the assessment with a good and positive trend is shown by “Finding ways to save raw materials and input materials”, enterprises and household businesses performed quite well with an average point of 3.66 and 58.92% of the respondents evaluated “good to very good”. This is, of course, because this is an important determinant of the revenue and profitability of the business. With “Organizing activities of communication, education and training on environmental protection for workers”, “Consultation with local communities and stakeholders on environmental issues of enterprises”, were done well by the enterprise, with the average point of 3.19 and 3.18. In which the number of votes for the implementation of these two activities at the average level is 34.44 percent and 36.51 percent, the number of votes that the implementation of these two activities as “good to very good” is 21.99 percent and 21.16 percent. Enterprises and production households also performed relatively well in “Covering vehicles carrying goods and materials” with an average point of 3.18 and 38.17 percent of the questionnaires evaluated “good to very good”, 33.20 percent of the reviews performed in an average. This is due to the increased awareness of business leaders about environmental protection and covering regulations for transportation have been stricter.

For the not-so-good reviews include, “Having an environmental protection license from the regulatory agency” the average point is only 2.41; “Fully fulfilling the obligations of environmental protection tax and fees in accordance with regulations”, with an average point of 2.79; “Promulgating separate regulations on environmental protection”, with an average point of 2.85; “Investing in advanced, modern, environmentally friendly technology, reducing emissions at stages where machines can be used”, with an average point of 2.79; “Greenhouse gas emission collection, storage and commercialization measures and technologies” with an average point of 2.19.

The cause of the above phenomenon comes from some issues, such as: the provisions of the discharge permit, the inappropriate tax regulations, make businesses incur too large expenses; the process of applying for a license is still too complicated, with many procedures, wasting time, waiting time is too long, even negative in this process; the process of applying for a license is still too complicated, with many procedures, wasting time, waiting time is too long, even negative in this process; businesses, production and business households have not really paid attention to making their own regulations on environmental protection, because they think that does not solve the problem; production scale of enterprises is not large, production capital is limited, human resources are trained mainly by the job training, so the investment in renovating equipment, production technology and gas treatment waste, wastewater is a difficult problem, not easy to find a solution.

4. Some Solutions Manage the Environment in Craft Villages in the Red River Delta

It can be said that enterprises, production households and individual businesses are properly aware of the current situation of air and water pollution as well as the extent of implementing some solutions to solve pollution problems in localities. Some solutions are implemented

well, but some solutions are not implemented well. However, the survey results showed that they had a straightforward look at the issues. This is also the basis for proposing solutions to reduce air pollution for craft villages:

Firstly, the craft villages in the Red River Delta need to put the air and water pollution solving in particular and environmental pollution in general first. Because the survey results show that it could be a priority issue that local management, businesses, individual business households, people are aware and need to deal with. Emissions, polluting wastewater from production activities of businesses, households as well as from transport activities need to be minimized in many different ways. For example, the government needs to check and monitor regularly and continuously the exhaust gas and wastewater discharge activities; guiding businesses and business households to build and implement production processes to save raw materials, fuel, materials, to limit gas emission, wastewater and to produce environmentally friendly. It is necessary to handle resolutely gas emission facilities, which violate regulations many times. Enterprises need to proactively reduce the generated gas and wastewater, and comply with the regulations on the time and amount of discharge.

Second, completing the system of regulations on controlling air and water pollution in craft villages, to simplify and transparent procedures and procedures for granting environmental licenses in general as well as for granting licenses for exhaust gas and wastewater discharge in particular. To do this, it is necessary to coordinate the implementation of management agencies and business leaders, and at the same time apply scientific and technological advances to monitoring, monitoring and evaluating discharge activities openly and transparently. If so, businesses have an incentive to apply for different licenses on environmental protection.

Third, promoting the use of tax and fee solutions related to environmental protection in general, air and water environment in particular. Management agencies should urge enterprises, individual business households to pay taxes and fees of gas emission and wastewater charges. It is necessary to check, examine and sanction strictly enterprises and individual business households that violate the regulations on environmental protection.

Fourth, supporting enterprises to improve technology to save raw materials, input materials, gas and wastewater treatment technology. In fact, the survey also shows that businesses and household businesses in the craft villages do not invest in technology improvement and waste gas treatment because they face many difficulties in capital and human resources to maintain production. Therefore, the state and local government should have programs and packages to support advanced production technologies, low emissions, financial, human resources or support through environmental protection funds for craft villages.

Fifth, raising more awareness of enterprise and individual business owners in the craft villages on water environmental protection in the locality. From there, awareness can be turned into concrete action. The main polluters in the locality have initiatives and solutions to protect the common environment in the handicraft village area. The management agencies, business owners, and business households at craft villages in the Red River Delta are aware. For example, through the sharing of funds, building and operating drainage systems, waste and gas treatment systems at craft villages from the state, enterprises, production facilities

and local residents, it is entirely possible to improve the quality of the air and water environment in the craft villages in a positive direction, is able to do.

5. Conclusion

Thus, air and water pollution is an alarming problem at craft villages in the Red River Delta region. This issue receives the attention of the government, enterprises, production households, businesses, and the community. Air and water pollution arises mainly from production activities of businesses and households; traffic activities etc. Recognizing the importance of the air and water environment protecting, many measures to reduce emissions have been implemented. Therefore, in order to solve the above problem, management agencies, authorities, businesses and people need to coordinate closely and to implement five solutions synchronously the next time. In this way, craft villages in the Red River Delta can have a clean air environment; guarantee the right to live in a clean environment of people.

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SUMMARIES

Marin Paunov

ON VIRUSES AND HUMANS: PSYCHOLOGICAL AND CULTURAL CHALLENGES TO HUMAN RESOURCES MANAGEMENT IN REMOTE WORKING CONDITIONS

The current Covid-19 pandemic provoked alternative work arrangements and a large proportion of employees started to work from home. Despite the initial technological euphoria, this change started showing not only positive, but serious negative phenomena in terms not only of organization and daily practices, but also of psychological and managerial nature. It brought a lot of new questions and problems concerning all soft management elements, especially in the domains of corporate cultures, work motivation and individual psychological responses. This article provides an overview of some major issues of this type and offers ways of tackling them. The new normal is not exactly normal and the old one already seems irrevocably lived-through. While there is no doubt that the future will offer a lot more flexibility and various options for combined distant and office work arrangements, this article explains why the current extent of working from home should rather remain as a transitory element responding to the exceptional circumstances.

Keywords: Organizational culture; distance working; working from home; human resources management; Covid-19

JEL: M12; M14; Z13

Alexander Ganchev

THE PERFORMANCE OF HEDGE FUND INDUSTRY DURING THE COVID-19 CRISIS – THEORETICAL CHARACTERISTICS AND EMPIRICAL ASPECTS

The study reveals that the COVID-19 crisis has had a strong but one-off negative impact on the hedge fund industry. It also shows that during the new coronavirus pandemic, the main components of the hedge fund industry achieved only partially their main investment goal, i.e. they as a whole provided a hedge of the investment risk but did not produce higher than the market return in the conditions of a growing capital market. In this situation, due to the relatively stable M&A market, the Event-Driven Risk Arbitrage strategy was undoubtedly most successful, followed by the Emerging Markets, the Global Macro and the Long/Short Equity strategies. The worst performance was reported for the Fixed Income Arbitrage strategy due to the currently overvalued bond markets and to the expectations for higher inflation rates in the countries with developed capital markets.

Keywords: hedge funds; investment strategies of hedge funds; portfolio performance; COVID-19

JEL: G11; G15; G23

Priya Harchandani

Samik Shome

TOURISM IN COVID-19 PANDEMIC: CONSEQUENCES AND THE WAY FORWARD

COVID-19 pandemic emerged as a shock to the world, leading it towards an unprecedented socioeconomic crisis. Amongst all the sectors of the global economy, tourism was hit the hardest.

Non-pharmaceutical interventions put in place to curb the spread of the disease, deeply impacted the activities in the global tourism community. Owing to the pandemic, the global community is being pushed into a recession. Tourism is crucial to the economic recovery of the world. Therefore, this study focuses on examining the consequences of the pandemic on the global tourism sector. Since tourism does not work in isolation and is intertwined with its associated sectors, the study considers the impact of the pandemic on aviation, hotel and accommodation and MSMEs in tourism. For this purpose, a regional analysis has been conducted. The findings reveal that the Asia-Pacific region has been consistently performing poorly in terms of tourism-related indicators. Europe stood second in place. However, during the resurgence of the second wave and new variants of the virus, it kept on switching places with the Asia-Pacific region. Tourism is considered to be a resilient sector as it bounces back to the pre-crisis levels eventually. However, the evolving nature of the pandemic has created huge difficulties for the sector to start its recovery. Hence the paper also discusses the future of travel in the next normal.

Keyword: COVID-19; Global tourism; Recession; Regional-analysis Next normal

JEL: M21; Z30; Z32; Z38

Natalia Maslii

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MODELING MIGRATION CHANGES ACCORDING TO ALTERNATIVE SCENARIOS IN THE CONTEXT OF THE GLOBAL COVID-19 PANDEMIC: THE EXAMPLE OF UKRAINE

Global processes significantly affect the mobility of the population. In the context of geopolitical transformation, globalization and quarantine restrictions of Covid-19, it is important to predict the development of the migration movement of countries that are developing. Therefore, the article is aimed at modelling migration changes according to alternative scenarios using the example of Ukraine.

The theoretical and methodological basis of the research is formed by a number of scientific works of leading scientists from different countries, statistical information on migration processes and socio-economic indicators of Ukraine's development, economic, mathematical and scenario methods. In the course of the study, the main factors were identified that more affect the migration processes of Ukraine, taking into account the trends in the impact of Covid-19 on them. These include population size, life expectancy, GDP per capita, average monthly wages, and the volume of remittances from individuals to Ukraine.

With the help of correlation-regression analysis, a multivariate econometric model of migration growth (reduction) has been built. This made it possible to study the absolute and relative influence of factors on the magnitude of the migration increase (decrease), determine the potential reserves for its increase (decrease), evaluate them using a comparative analysis and carry out predictive calculations of the volume of migration increase (decrease) in Ukraine.

Keywords: migration; migration movement; migration increase; emigrants; immigrants; multivariate econometric model; scenarios; Covid-19

JEL: C82; F22; F24; J11

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IS THE CORPORATE SOLVENCY CONUNDRUM PRIMARILY A BALKAN ISSUE OR A BROADER EUROPEAN CONTINENTAL MISUNDERSTANDING?

As a consequence of the coronavirus outbreak, the corporate “(in)solvency” issue will probably be one of the most frequently discussed topics in the business and economics fields. We analysed the meaning of the term solvency and the solvency assessment methodology in the papers published in the journals indexed in SSCI from 01.01.2017 to 31.12.2019. We have found that the term “solvency” is inadequately used by the authors from Roman law countries, particularly by those who are from the East European countries. We have also found that the inadequate use of the solvency assessment methodology is conditioned by the scientific field of the researchers. The further the authors are from the legal and accounting fields, the more they are inclined to misuse the term (in)solvent and to introduce the solvency ratio. Finally, we explained the probable origin of this confusion.

Keywords: solvency; solvency ratio; solvency analysis; firm performance; semantics
JEL: M41; K22

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EVALUATING THE IMPACTS OF PASSENGERS’ RIGHTS POLICY ON THE COMPETITIVENESS OF AIRLINES AND AIRPORT OPERATORS USING THE DYNAMIC PROGRAMMING APPROACH

The passengers’ rights protection policy is crucial for providing the quality of air transport services and has a significant impact on the competitiveness of airlines and airport operators. This impact can be measured by defining a system of quantitative and qualitative indicators and can be managed by adopting adequate efficiency-enhancing measures of this policy that contribute to the greater competitiveness of all the players in the European air transport market. The study aims to present the opportunities of a dynamic programming approach to enhance the efficiency of passenger rights’ protection policy in terms of the competitiveness of airlines and airport operators. The application of the model has been empirically tested and, on this basis, a proposal to update the passengers’ rights protection policy has been worked out by the authors and the expected impacts and effects of its implementation have been examined.

Keywords: air transport; passenger rights policy; dynamic programming
JEL: R41; R48

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THE SYSTEM OF EVALUATION EFFICIENCY OF THE STRATEGY OF SUSTAINABLE DEVELOPMENT OF THE ENTERPRISE IN THE DECENTRALIZATION CONDITIONS

The article proposes a scientific and methodological approach to strategising the development of a manufacturing enterprise in a decentralised environment based on the principle of feedback. This approach involves taking into account the direct and feedback indicators of the enterprise, aimed at increasing its competitiveness and achieving sustainable development goals. The authors propose to assess the level of development of the production enterprise in decentralisation, taking into account the multiplier effect of interaction with the united territorial community on the basis of the target approach (indicators are distributed according to the goals of the enterprise), taking into account the main directions of sustainable development component, each of which has its own system of evaluation indicators.

The proposed methodological approach to assessing the level of development of a production enterprise in decentralisation allowed to assess the development of the enterprise in accordance with its qualitative and quantitative characteristics in each of the areas of sustainable development (social, economic, environmental, budget), taking into account their interaction levels. A scientific and methodological approach to modelling the management system of the dynamic state of the production enterprise in terms of decentralisation, which provides for the formation of a model of development of the production enterprise in cooperation with OTG on indicators of its development. The model of management of development of the industrial enterprise in the conditions of decentralisation for LLC TIS, which is located in the territory of the Vizyr UTC of the Odessa region is constructed.

Keywords: sustainable development strategy; decentralisation; territorial community; comprehensive assessment of the strategy

JEL: M21; R12

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FUZZY LOGIC DECISION-MAKING MODEL FOR TECHNOLOGY FORESIGHT

A new decision-making model in technology foresight based on fuzzy logic is proposed. The choice of technology as disruptive or critical doesn't depend on the subjective expert's opinion, but bases on the mathematically justified limits of technologies criticality. The basis of the model is the fuzzy inference system by Mamdani algorithm. Five of the most important criteria of criticality have been used as input linguistic variables. A new approach to defining membership functions based on equidistant derivative points is proposed and described in detail. The functioning of the model is considered by example. The influence of the application of different membership functions on the criticality assessment is shown. A comparison between the fuzzy model and classic expert model is also conducted.

Keywords: critical technologies; disruptive technologies; fuzzy logic; membership function determination; technology foresight
JEL: C30; C51; O20

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ON THE ISSUE OF COMPLIANCE OF THE RESOURCING OF THE SECURITY AND DEFENCE SECTOR OF UKRAINE WITH THE CHARACTERISTICS OF THE SYSTEM

The article summarizes the arguments and counterarguments in the scientific discussion on the development of a scientific problem for the creation of a modern concept of resourcing for the security and defence sector of Ukraine. The main purpose of the study is to analyze the category of “resourcing” to formulate the optimal scientifically grounded ways of further research. The systematization of literary sources and approaches to solving the problem of formulating the definition of “resourcing” has shown the presence of a wide range of scientific ideas and approaches to determining its content. The relevance of solving this scientific problem lies in the fact that the existing approaches to the resourcing of the defence needs of Ukraine require clarification and improvement. This is confirmed by the publication of several conceptual documents on ensuring the national security and defence of Ukraine. The study is structured in the following logical sequence: an analysis of approaches to determining the content of “resourcing” is carried out; the process of resourcing of the security and defence sector of Ukraine is analyzed for compliance with the characteristics that characterize the system. Methods of analysis, system analysis, and synthesis became the methodological tools of the study. The year from 1998 to the present was chosen as the study period for the content of the key definition. The object of the research is the resourcing of the security and defence sector of Ukraine. Since the ability to acquire the necessary capabilities by the components of the security and defence sector of Ukraine in the course of repelling armed aggression from the Russian Federation depends on the level of timely and full provision of defence needs. The study empirically confirms and theoretically proves the need for further research of the resourcing system as a subsystem of the security and defence sector of Ukraine of the national security system of Ukraine as a whole. The results of the study can be useful for scientists and managers, embracing the issues of comprehensively meeting the needs of the defence of Ukraine.

Keywords: resourcing; resourcing system; security and defence sector of Ukraine
JEL: F52; H56

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CRAFT VILLAGE DEVELOPMENT AND ENVIRONMENTAL PROTECTION CHALLENGES IN THE RED RIVER DELTA OF VIETNAM

This paper examines and assesses craft village development and challenges in the environmental management of craft villages in the Red River Delta region of Vietnam. This is the area where most of the craft villages of the country are concentrated. They contribute to creating jobs, increasing incomes for rural people, contributing to the successful implementation of the goal of hunger

eradication and poverty reduction. However, this rapid development also creates many environmental consequences for rural areas. From the data published by state agencies and case studies in some craft villages in the Red River Delta, this article shows that economic development, rural urbanization create dynamism force for enterprises, households in craft villages to expand production, but also leads to fierce market competition between craft villages as well as environmental pollution. Although Vietnam has implemented many environmental protection policies, pollution in craft villages is still serious. Therefore, in order to ensure the handicraft village environment, research shows that it is necessary to promote supervision and monitoring of the implementation of environmental protection measures by businesses and households, in addition to building a policy of reasonably economic development for this area.

Keywords: environmental pollution; Red River Delta; craft villages; enterprises

JEL: R11