

Development of a Model of Design Thinking Hybrid Implementation in the Post-pandemic World

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Abstract—In the given research project possible means of adapting design thinking to the most promising work mode of the post-covid area – a hybrid mode – are going to be elaborated. Along with an in-depth study of the latest papers on Covid-19 impact on the workflow hybridization as well as on innovation creation process via design thinking application, an empirical study of the considered approach applied in a hybrid mode will be also conducted. The result of the given project will be an experiment conducted in the business environment on the implementation of the proposed design thinking hybrid and an analysis of the results obtained for further research in this direction.

I. INTRODUCTION

The conduction of the given research project is aimed at identifying the model of design thinking approach which would be applicable in the hybrid mode in the context of Covid-19 influence on the future of work. In the Table I the conceptual apparatus of the work is shown. It includes the given by authors definition of concepts necessary to provide a research context.

TABLE I. CONCEPTUAL APPARATUS OF THE RESEARCH

Concept	Definition
Innovation	The result of intellectual activity characterized by the presence of novelty or improvement (in a form of a product, a process, or a business model) that creates additional value (in efficiency, quality superiority, leadership, profit) relative to existing solutions in a demanded market for an organization.
Model	A coherent set of principles that subordinate the process of creative organization of intellectual activity to achieve a certain result within adaptation of certain approach to the environment context; the innovation creation model provides added value for the organization's operations
Approach	A coherent set of techniques for organizing intellectual activity, the implementation of which is to provide the result of this activity; The result of the implementation of an approach to creating innovations is considered a solution that has additional value for the organization's activities.
Post-pandemic	Designation of the period of economic recovery after prolonged exposure to epidemiological restrictions, which are official and universal.
Hybrid mode	The organization of the employee's work activity is fundamentally blended and includes both onsite and offsite involvement to the workplace, still making virtual cooperation the main part of communication with coworkers, carried out due to the widespread use of ICT.

Theoretical foundations are based on studies of the pandemic influence on the future of work, and on the process of creating innovations and thus aimed application of the design thinking under constraints considered, in particular. Methodological foundations are based on an experiment conduction in the business environment aimed to appropiate the proposed model of design thinking for a hybrid mode, also the given model is expected to reflect both theoretical and empirical findings gained during analysis of the expert survey results. An empirical part of the research is in the progress at the time of paper submission.

II. LITERATURE REVIEW

The study of the research context was divided into three composing parts of the topic under consideration, thus implying the discovery of gaps in the relevant research since the given study process delves into the following areas:

- Hybrid mode, including the pandemic impact on this mode of work and post-covid expectations
- Creating innovations and the pandemic impact on this process, including for post-covid period
- Design thinking approach and the pandemic impact on its implementation, including post-covid expectations

A. Hybrid mode: the impact of Covid-19

After the omnipresent onlinification (depending on the possibility given by the industry's specifics or the presence of loyal to virtualization properties in the particular job position) of work during the lockdown period, the status of the most probable and promising work mode gradually switched from a remote mode to a hybrid mode in the post-pandemic perspective. Thus, McKinsey's latest report on the future state of work in the post-covid period highlights the fact that the share of hybrid employee involvement relative to the pre-pandemic period (especially for the computer-based occupations) and the expected acceleration of this trend after the pandemic ends as one of the main results of the impact of Covid-19 on the organization of work [17]. Simultaneously it is stated that the degree of distribution of the hybrid mode in the post-pandemic period depends on the initial predisposition of a particular occupation to a remote mode, also the overall presence of tasks predisposed to a virtual environment, the industry's specifics, and even the level of the country's economy [16],[18].

Regarding the topic of the hybrid mode, a pandemic has become a catalyst for the research conduction in the scientific community. The most highlighted topic in the pre-pandemic period was research on the implementation of a hybrid mode to the learning environment and finding of corresponding means to achieve effectiveness while online-elements stayed as asynchronous ones [13]. The given topic is still actual in the current landscape of scientific papers, being added by such directions as effectiveness of a hybrid mode and the way this mode will be expectedly reflected in future, seeking for principles of effective hybrid work accomplishment, usage of ICT, and research of risks and challenges, separately.

The most popular research direction at the moment is the study of the effectiveness of the hybrid and its future in general. It is noteworthy that there is a positive impact of the hybrid mode as the main one of labor organization noted, both in terms of business (some economic indicators [21], performance level of planned work [4],[21]), and the employees themselves (fact or potential of improving the work-life balance [4],[9],[24], maintaining efficiency in the workplace [2],[5],[24]). The expectation of the influence expansion of this mode on the labor organization in the post-pandemic period finds its confirmations as well [2],[4],[5]. However, research in this area usually considers the hybrid mode in general detail, without going down to the implementation of isolated types of business processes in organizations. Particularly, in these studies it is refused to provide the results of studying the process of creating innovations in a hybrid mode.

Among a number of papers that directly study the maintaining of principles for the effective hybrid mode implementation, the following significant statements could be noted: the use of being in the same physical space in order to stimulate creative and innovative interaction, maintaining asynchronous online work when it is necessary, and the need to introduce a coordinating element regarding tasks requiring hybrid interaction [15][20]. It should be noted that these studies respectively reflect a general consideration of the hybrid mode, however, it is assumed that the best practices founded during this part of hybrid mode research could be applied to the process of creating innovations as well.

Within the framework of a few papers focused on the direct study of the use of ICT, the fundamental importance of ICT in the implementation of a hybrid mode is emphasized: the way ICT is introduced into certain interaction processes of employees directly affects both their involvement in the work process and obtaining the results of joint activities [10]. Similarly, it is assumed that the findings on the role of ICT are applicable to the process of creating innovations, in particular.

Finally, among either a few works that directly study the risks and challenges of a hybrid mode, the following observations could be distinguished, which are potentially also relevant within the framework of an isolated process of creating innovations: the most feasible to occur problems of socialization (such as miscommunication, biased expectations, social distancing, lack of innovation potential, and frustration) could be leveled and even prevent with the help of pre-

designed interaction in the group, including in terms of virtual interaction [27].

It is worth noting that among the current research on the topic of the hybrid mode as a main mode of labor organization in the post-pandemic period, there is no tendency to delve into some isolated-by-an-aim processes, and in particular the process of innovations creation, also to the approaches to creating innovations used in the process mentioned above. Simultaneously, it can be assumed that the hybrid mode of work is not just a combination of features of both virtual and non-virtual modes, but is a separate mode of work that has differentiation on features by its nature (the features considered below also assumed to be taken into account within hybrid process development), namely:

- A unique-per-person combination of synchronous and asynchronous communication, the subjects of which may not have a stable characteristic of being specifically in an online or offline environment for a certain period of time (e.g., this period could be considered as a planned duration of some part of project scope, or a quarter performance dynamic within project activity, etc.);
- An intersection of the contexts of a subject's work, performed simultaneously within the framework of both online and offline interactions;
- The need to continuously maintain the quality of a such interaction, which is directly under responsibility of the given subject of a team cooperation;
- The presence of multiple (i.e., distinguishable by nature) nature of information sources (namely, online and offline sources) and the ensuing implicit obligation to align the information context;
- The presence of a "shaky", unstable in nature context of working interaction in general.

Thus, the anticipated presence of the hybrid mode's unique properties of the hybrid could act as an accelerator for research activity in this area, in particular regarding the process of creating innovations, including the adaptation of approaches for creating innovations to the given work mode's characteristics.

B. Creation of innovations: the impact of Covid-19

Throughout the pandemic period duration up to the time of the given research project being conducted inclusively, the most popular research direction within the covid-affected innovation creation is the adaptation of this process to the conditions of a virtual environment, overwhelmingly; the given statement is also valid for the considered research in the post-pandemic period [28]. Additionally, among the relevant papers on the creation of innovations, research on the effectiveness of creating innovations in an epidemiological context as well as a direct consideration of the expected evolution in features of the given process in the post-pandemic period could be highlighted.

In the context of reaction to pandemic, research highlights that the process of creating innovations was influenced by Covid-19 pandemic despite the general requirement for

physical collaboration as a guarantee of effective results obtained [23]. Comparing the current and expected future state of the process of creating innovations with the pre-pandemic period, studies in this direction highlight the fact of a general change in the goal setting: if in the pre-pandemic, the main interest was the creation of solutions and mastery of technologies, while during – the adaptation of processes through their digitalization, as well as cost reduction [22]. Also, there is one more important finding: direct relationship between organizational maturity in digitalization (creation of innovations is included) and economic indicators over the pandemic-related restrictions period were registered [8].

Among the articles on the process effectiveness of creating innovations in the context under consideration, the most topical research issue is about the efficiency level of geographically remote teams. Thus, an insufficient ability of the current technological communication tools in realizing the experience of face-to-face interaction was found as the main limitation of remote team effectiveness [1][8][22] (the given tool efficiency issue was also highlighted [7] within pre-pandemic research). Another side of improving the given process' efficiency was revealed regarding the increase in use of the open innovation approaches during the containment of the Covid-19 pandemic. Presumably, the reason of a such turn to the open innovation ideology is the previously demonstrated cost reduction [3][8] (as it also is demonstrated in the pre-pandemic studies, it is not necessarily on the own experience [11]) due to the principles of its organization, including its identified predisposition to digitalization.

Finally, regarding the post-pandemic process of creating innovations, the main assumption is stated for a preservation of the processes adapted during the constraints at least in the short term since the pandemic's end [16][17][23]. The vector of goal setting for this process will probably remain, however it is expected by findings to coincide with the pre-pandemic vector in the medium term [16][23]. There is also a point to potential increase in organizational motivation to adhere to open policy in the field of innovation. Presumably, this may become a factor in an increase in the number of distributed teams, hence increased requirements for the efficiency of such interaction and its technological support. A few related studies also indicate the possibility of using AR/VR technologies to create a new generation of communication tools for use in conditions of limited interaction in future [14][23][26].

Summing up, within the present research considering the prospects for changing the process of creating innovations due to the systemic impact of Covid-19 pandemic on organization of labor, there is a lack of focus on the anticipated, assumed or factual transformation in the hybrid mode context. The main research focus still remains on the complete virtualization of the given process (for example, from the usage of regular ICT tools to the creation of innovative tools aimed to provide an immersive effect in the creative joint process identical to the interaction in an offline environment). It is assumed that the findings done within the given research direction could only be partially relevant to the implementation of the process considered in a hybrid mode.

C. Design thinking: the impact of Covid-19

Like the previously mentioned research avenues of hybrid mode and creation of innovations, the Covid-19 pandemic-driven conditions both of living and the whole nature of interaction have prompted research direction in the application of design thinking approach in order to achieve optimally fast and best-suited solutions for a conditional user of such in-demand solutions [28]. A main characteristic of the studies under consideration is the presence of a focus on the immediate results of the application of design thinking to the process of creation innovations itself, and not on the features of the process of implementing this approach in new conditions [28], which thus makes the results of these studies unacceptable in relation to the focus of the given research project.

To date, there is also a few papers considering the way of design thinking process adaptation of design thinking to working conditions caused by epidemiological restrictions during Covid-19 pandemic. It is noteworthy that these studies highlight the historical absence of predisposition of design thinking approach to be applied in a somehow virtual context (including the use online tools) [14][25], while the factual presence of a number of adapted models of the given approach probably indicates a high-level potential of being flexible regarding the adhering to a particular context [28]. In Fig. 1 the most well-known design thinking models compared with Stanford's d.school model as a reference are shown [28]. It is also notable that the main challenge for a virtual design thinking process participants was the observance of all stages of the approach, as well as their full implementation, which is not inferior in quality to a relatively non-virtual environment [25].

Stanford [1]	Empathize	Define	Ideate	Prototype	Test					
IDEO [2]	Discovery	Interpretation	Ideation	Experimentation	Evolution					
Google [3]	Understand	Define	Sketch	Decide	Prototype	Validate				
Austin Center for Design [4]	Ethnography		Synthesis		Prototyping					
Mary Cantwell (DEPAt) [5]	Discover	Empathize		Experiment	Produce					
SAP [6]	Discover	Prototype		Deploy						
Design Council UK [7]	Discover	Define	Develop	Deliver						
Design for America [8]	Identify	Immerse	Reframe	Ideate	Build	Test				
Intel [9]	Identity	Research	Brainstorm	Draft	Research & define	Prepare	Build parts	Build prototype	Test/Validate	Communicate

1. <https://web.stanford.edu/~mshanka/MichaelShanks/files/509554.pdf>
 2. <https://designthinking.ideo.com/>
 3. <https://designsprintkit.withgoogle.com/>
 4. <https://www.ac4d.com/worksheets>
 5. <https://www.deepdesignthinking.com/>
 6. <https://tegrous.com/sap-design-thinking-workshop/#~:text=SAP%20Design%20is%20a,customer%2C%20resulting%20in%20innovative%20solutions.>
 7. <https://innovationenglish.sites.ku.dk/model/double-diamond-2/>
 8. <https://designforamerica.com/resources/>
 9. https://d1o3y9g0uux3.cloudfront.net/_409081c3ac0d45430096de37899c2ada/mle/db/887/8510/annual_report/2021+Form+10K_BMK.pdf

Fig. 1. A comparison of design thinking approach's models

Also, regarding the research direction on design thinking process evolution in the post-pandemic, there are interesting highlights about the vector of an evolution considered (however, these are not tied to a hybrid mode of work): thus,

the wide use of advanced analytics solutions and the building of a skill-mixed team are seen as key principles [19] for the effective realization of the design thinking approach in the gradually changed work environment new reality. Either an applicable to the given research project finding of efficiency issues regarding the use of online creative engagement tools, and moreover the fact that the given issue is most valid among participants of virtual design thinking sessions who had some participation experience in offline design thinking session done in the pre-pandemic period [28].

At the same time, there is a current lack of research considering the vector of potential post-pandemical evolution model of design thinking approach, including its application within a hybrid mode of work. By date, a single paper is noted for the consideration of design thinking in a hybrid environment (a pre-pandemic period paper) – but the study being considered may not be applicable to the given research due to its understanding of a hybrid as a usage of ICT tools of all participants while cooperating in a one physical place for a whole process [6].

D. Research gap

Thus, within the theoretical part of the research, the most fundamental components of the topic under consideration were covered:

- A hybrid mode of work regarding its unique features and its future in the post-covid;
- Creation of innovations after the pandemic ends, and;
- Finally, a design thinking approach application affected by epidemiological restrictions and influenced-by policy, including in a hybrid mode.

It is noteworthy that in the existing related to the given research papers on the hybrid mode there is no consideration of the process of creating innovations, which is different from other operational activities by its creative nature. Just as within the framework of actual research on the creating innovations processes' evolution there is also the absence of focus on the hybrid mode context, despite its factual proclamation as the most expected to go on stage mode of labor organization in the post-pandemic period plus the assumed features, which are expected to be taken into account regarding the efficient implementation of the new creative process.

The most narrow-topic and pointwise articles on design thinking approach which are relevant for the given research avenue also hold either a tendency to consider the onlinification of the process and its features (it is also about the consideration of the experience of using some of online tools to support the collaborative creative process in a virtual environment), or the focus on the direct results of design thinking application in response to an emerging need or demand which is required to be resolved with efficiency met in an optimally short time due to accelerated expectations due to the epidemiological restrictions' influence.

Simultaneously, there is an assumption of the actual relevance presence of research on the adaptation of the process of creation innovations specifically and directly to a hybrid mode since this mode of work is not a simple sum of both

virtual and non-virtual modes but a substantive form of labor organization with its own properties which should be addressed while developing some processes within this mode, including creative ones.

Finally, the literature review has turned out that the current research landscape could propose only partial solutions for the being expected to emerge issues of implementing creative processes in the post-covid times, including the application of a design thinking approach without exploring this research avenue directly, thus creating an emerging demand for a conduction of research in the topic being considered.

III. RESEARCH METHODOLOGY

The given research methodology is divided into the following phases:

- Conduct a survey among experts on the topic of a hybrid mode of work experience, focusing on the participation in design thinking sessions in a hybrid communication environment;
- Prepare an experimental model of design thinking which will be assumed for being suitable in hybrid mode joint activity conditions;
- Conduct an experiment using the design thinking model prepared in a business environment.

At the time of paper submission, an empirical part of the given study is in progress. Note: both a survey and an experiment will be conducted in a context of IT industry since the design thinking approach is highlighted as one of the most widely used innovation creation approaches in this industry [3][11], what potentially makes this effort valuable for being conducted in the given context. Consider the listed steps of an empirical part in detail:

A. Survey

The purpose of the expert survey is to collect data on real experience of work in a hybrid mode focusing on the joint activity of creating innovations in such conditions, including the use of design thinking approach. An expert is considered as a person who had an experience of working in a hybrid mode during the last year (the period from February-March, 2021, to March, 2022), including the specific experience of creating innovations in a hybrid mode, especially with use of design thinking approach. The survey period is from the second half of February, 2022, to the first half of March, 2022. It is expected to have a sample of $N \geq 20$ as a guarantee of representative results obtained.

Consider the parts of the given survey:

1) *General*: this part includes questions on the work experience in years, some information about the employer (how many years has it existed, the number of employees it has, is it an international company or not) aimed to structure the received answers in order to find any patterns based on a type of company's features obtained.

2) *Hybrid mode*: this part includes questions on experience of a hybrid work (personal and colleagues' experience, reasons

of a choice, issues seen), creating innovations via this mode of work (personal and colleagues' experience, reasons of motivation and demotivations, issues seen).

3) *Design thinking in a hybrid mode*: this part includes questions on design thinking experience (previous non-virtual and virtual experience of design thinking, current efficiency of design thinking conducted hybridally, features highlighted, issues and difficulties faced during its hybrid conduction).

And according to the conditions expected, the given survey was conducted among 23 participants who meet the criteria target audience criteria above (they are employees of companies included in the IT cluster of the Volga region such as Orion Innovations (ex-MERA), Epam, Yandex, Lad, Intel, Netracker, etc.).

Pursuant to *General* part, the largest share of the sample was made up of large-sized international companies' employees that has been on the market for more than 10 years. Over the past year (February-March`21-March`22) 51.2% of respondents spent half or more of their working time in a hybrid mode, and with respect to the same colleagues' distribution of working time respondents answer confidently in 69.5% of cases. Thus, it can be assumed that the hybrid format (at least in IT industry) is a currently gaining its popularity mode of work and it will probably keep its popularity in the post-pandemic period.

According to *Hybrid mode* part, the most common reason for choosing the mode of work considered is the possibility of improving the quality of the interaction results to create solutions having innovative potential (82.6% of responses). Perhaps these circumstances of choice indicate issues in the processes for creating innovations related to its realization in the remote mode, the mostly widespread mode of work during the widespread Covid-19 pandemic. However, according to the study, a hybrid mode rather had not become "a solution" to such process issues also related to remote mode: 73.9% of respondents consider the simultaneous intersection and combination of both synchronous and asynchronous communications within the single process as the most common process issue. This problem could probably be considered as critical for obtaining solutions that are valuable from the point of view of innovative quality, since about 91% of respondents had experience of such activities conducted in a hybrid mode.

Simultaneously, the main motivating factor for the transition and/or implementation of innovation creation process in a hybrid mode is the possibility of intramural communication with at least some of colleagues (82.6% of responses). This circumstance may emphasize the need for research on the adaptation of innovation creation processes to a hybrid mode. It is also noteworthy that the most popular demotivating factor in choosing this mode of work is the ability to communicate with colleagues online (39.1% of responses). In turn, this fact revealed probably confirms the assumption of a long-term impact of the pandemic consequences on the choice of mode of work, and on the process of creating innovations in particular [28].

Regarding *Design thinking in a hybrid mode* part's results, due to a control question about using design thinking in a

hybrid mode of work so that to improve the relevance level of results obtained, only 60.8% of respondents stated of such experience, so further research was continued within this much more localized sample.

According to study, 56.3% of respondents agreed on adaptability of design thinking to a hybrid mode, while this approach was actually being adapted to a hybrid mode in only half of these cases; moreover, one of four such cases were unsuccessful in terms of process quality and results obtained. Regarding the offline implementation of design thinking, 43.8% of respondents reported a decrease in the effectiveness of a hybrid implementation. And in comparison, only a quarter of the sample noted a decrease in the level of performance in contrast to online implementation.

Considering the actual use of design thinking phases during its hybrid realization (based on d.school model), the most common phase was Ideate while Empathy and Test were mostly ignored by some reason in ~60% of cases). Within Ideate phase, respondents tend to report about facing some difficulties during its running, however, this fact could be partly explained by the frequency of use (for example, in Empathy phase some issues were registered in 40% of cases, while during Ideate phase this number exceeded 90%).

Respondents also noted the need to be involved online and offline simultaneously and the presence of limitations of online team interaction tools (both for ~78%), as well as the possible issues during application of some design thinking techniques (in ~56%) as the most common problems in the implementation of hybrid design thinking. Also, it is notable that every participant had experienced some difficulties with online communications as a part of an implementation in a hybrid mode, while half of them additionally had issues at the junction of online and offline interaction in a team.

Regarding the impressions of the hybrid implementation, for 31.3% of respondents this experience was mostly unique (e.g. cannot be strictly related to mostly either the online or offline implementation), while for 43.8% of the study participants it remained mostly of an online implementation of design-thinking, this may be reflected this may probably due to the widespread use of the same online tools that are used in the remote work format. Interesting to note that the need to act offline most of the time during the hybrid implementation of design thinking was mentioned by 81.3%, however, this need was realized only by 43.8% of respondents. There is also an interesting proportion of whom spent most of their time implementing design thinking offline without the need to act offline, it is 12.5% of the sample.

Thus, these findings probably indicate the likely absence of an established structure of a hybrid design thinking practice which could guarantee its effective implementation to users mostly in terms of the process itself (at least in the field of IT) in the context of hybrid mode both current and potential prevalence in the post-pandemic.

In total, the probable key issue of a hybrid implementation of design thinking is the problem of combining both synchronous and asynchronous interaction within the single process in the absence of a practical guide to the qualitative

process of its implementing addressing all the important features of a hybrid mode of work. Therefore, the proposed experimental model below, in view of satisfying both the features and difficulties of a hybrid mode, could potentially provide an effective way of a such implementation, which in turn should be verified by experimentally running this model.

B. Experimental model

The purpose of this research stage is to develop a design thinking model applicable for the hybrid mode conditions, thus to will be validated during the experimental design thinking session carried out in a business environment as the next research phase. It is supposed that the efficient use of design thinking in a hybrid mode directly depends on as addressing the given mode’s features, as the corresponding to both principles of efficient design thinking realization and key design qualities (environment, techniques, practices, abilities, attributes, values, thinking modes and awareness of blocks [12]), the observance of which could be considered as a guarantee of a quality process and valuable results obtained within the design thinking approach [12]. Thus, a supposedly hybrid design thinking model should reflect the following principles:

- Ensuring non-intersection of work contexts as well as sources of information for all the design thinking process participants;
- Ensuring the presence of strictly synchronous communication at the stages of creative coordination of actions in the design thinking process (e.g., brainstorming activity) and strictly asynchronous communication at the stages of implementation of agreed actions (e.g., prototyping an approved solution);
- Determine the best-suited process roles of design thinking session participants before it starts, as well as a person who will hold the facilitator role of the process owner;
- Ensure the presence of process participants belonging to different specialties so that receive most valuable results, including to ensure the best distribution of process roles;
- The use of online tools for joint creative interaction should take place at the stages of asynchronous communication after coordinated actions within the framework of synchronous communication.

The principles listed above should be applied in an experimental model and tested through the following experiment to prove or disprove their efficiency regarding design thinking application in a hybrid mode.

Thus, the experimental model is designed to consist of both synchronous and asynchronous type of interaction within one design thinking phase, where the first type of which is also a connector for two phases of the approach – in this research Stanford’s d.school model is applied as a reference of design thinking phases, shown in Fig. 2 (a.). The rest of principles is expected to be expressed within the experiment. A schema of an experimental model of design thinking for a hybrid mode is shown in Fig. 2 (b.). This hybrid model could be described as “a chain sequence of synchronous and asynchronous

interaction within the design thinking process based on d.school model, in which synchronous interaction acts as a connector between two phases of design thinking process, as well as the beginning and end of the entire process”; the additional phase "post-process" is aimed to mark the end of the design thinking process and summing up the final results among the participants in the process.

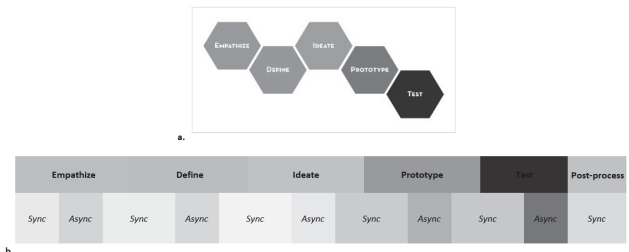


Fig. 2. Stanford’s d.school model (a.) and an experimental model for a hybrid mode (b.)

C. Design thinking experiment

The purpose of the experiment conduction is to prove or refute a hypothesis of the proposed design thinking hybrid model’s efficiency which in turn reflects the supposed principles of effective conducting of a design thinking approach in the hybrid mode.

The experiment was conducted in the second half of March, 2022, with regard to the need to analyze the results obtained from the experts survey and therefore adapt the prepared model if applicable. As mentioned in the given section above, the experiment had been carried out in a business environment (an international IT company that has been on the market for more than 10 years, with more than 250 employees). In this experiment four employees of different specialties were involved to maintain interaction in a hybrid mode throughout the entire pilot process. Regarding the above mentioned, among the participants were developer (A), business analyst (B), designer (C), project manager (D). It is assumed that during the experimental model pilot running all participants adhere to the role inherent in their formal function in the company; so the project manager (D) was appointed as the process facilitator role (this role is responsible to monitor compliance with the principles of the experimental model while not interfering in the process itself), please see the Table II for participants’ disposition described during the whole experimental design thinking process.

Aimed to provide qualitative experiment conduction, all participants were introduced to the proposed principles of a model, focusing mainly on the features of combining synchronous and asynchronous communication. The tools for implementing interaction were also predetermined: Zoom (addressing the need to maintain synchronous contact with whom are physically absent from the office at the moment of collaboration) and Figma (addressing the need in the terms of space using of FigJam as a single environment for organizing joint creative activities). Thus, the principles of the proposed model for implementing design thinking in a hybrid mode were ensured.

To start the experiment, participants were provided with the design thinking task to find an innovative solution that has a high social significance: to increase level of social integration for people with hearing impairment. In view of the given research focus on the hybrid design thinking process tested via the proposed experimental model, the accent of further consideration will be directly on the *process* experience itself, presented retrospectively.

The whole experiment conducting took three working days. It should be highlighted that for all the experiment time length the format of participation had to be alternated what is aimed to ensure a strict form of a hybrid mode for all the participants, except the process facilitator always watched the process online. So, according to the conditions, each participant could not be only in person or remotely throughout the entire duration of the experiment. Also, at Test phase three people (testers, see Table II) who were not involved in the experiment itself were invited to independently evaluate the solution online. In Table II the scheme of the distribution of participants regarding each day of an experiment is presented detail.

TABLE II. PARTICIPANTS' DISPOSITION DURING THE EXPERIMENT

Day	Design thinking phase	Online	Offline	Always online
1	Emphasize Define	A	B C	D
2	Ideate Prototype	A B	C	D
3	Test Post-process	C	A B	D testers

On the first day of an experiment the phases Emphasize and Define were implemented: the process began with a conference via Zoom platform, where participants determined the tasks and ways to achieve them within the asynchronous part of this phase with use of Figma. After the completion of the asynchronous work, a conference was also organized with the purpose to summarize the results of the asynchronous part, to adjust the direction and move to the Define phase with the definition of further tasks for asynchronous execution. The first conference lasted about an hour, the next was about 2 hours, so asynchronous part took about 5 hours.

On the second day, Ideate and Prototype phases were implemented: the process began similarly with Zoom conference, in which the results of the asynchronous part of Define phase were summed up and the transition to the discussion in Ideate phase. After the implementation of the asynchronous part related to Ideate phase, another conference was held to sum up the results of the phase and distribute tasks for the asynchronous part of Prototype phase. The first conference lasted about 1.5 hours, the second was about half an hour, so the asynchronous part took about 6 hours.

On the last day, phases Test and Post-process were implemented. The process started with a conference summing up the results of Prototype phase with a transition to a discussion of the organization of Test phase. At this very phase three people were additionally involved to conduct the independent assessment of the design thinking results, as mentioned above. Such each testing took place in isolation

under the auspices of only one of three experiment participants. Finally, a conference was organized to implement Post-process phase, within which the results were summed up and further prospects for the development of the proposed solution were formulated. The first conference lasted about half an hour, the second about an hour, so the asynchronous part of the work was about 6.5 hours. So, total synchronous part of experiment took about 12.5 hours, which is ~52%, and the asynchronous part was done in about 11.5 hours, which is ~48% of the experiment time; it is while each design process participant took from ~30% up to ~60% in each type of interaction. Finally, to evaluate the effectiveness of the proposed experimental model, an interview with process participants was conducted, shown in Table III.

TABLE III. THE RESULTS OF POST-EXPERIMENT INTERVIEW OF PROCESS PARTICIPANTS

Question	A	B	C
Does the proposed design thinking model solve the problem of combining synchronous and asynchronous interaction in a hybrid format?	Yes	Yes, but there are difficulties due to the strict split of sync.-async. phases due to limited time	Yes
In what type of interaction (sync./async.) did you experience difficulties? Which ones?	Most likely in the sync. type; Transition to a new process effect; Lots of meetings	No issues excepting the limited time	No issues
Could it be more effective to implement design thinking strictly remotely or on-site?	Yes, on-site realization is a most effective one	Not sure	Not sure, but previous remote experience was failed, in fact
What are the “-“ of this model can you list?	Strict choice of tools; Sometimes need more time; Lots of meetings	Quite intensive pace	Not sure, but possible issues with n-sized team, where n>3
What are the “+“ of this model can you list?	The absence of parallel communications is a big plus of this approach	Strict split of phases and interactions; The ability to define a scope of tasks to work on independently	Defined scope; Transparent teamwork; No mess in interactions
How do you generally rate the implementation of the experimental model from 1 to 5, where 1 is for very unsuccessful and 5 is for very successful?	3	4	4

Thus, based on the post-experiment interview results obtained, the following conclusions on the experimental model could be proposed:

- The structure of this model probably could help to reduce the problem of intersection of different types of

interaction between teammates which may be noted as the key hybrid process issue, this is also may be considered as the main advantage of the model;

- The hybrid implementation of design thinking is probably inferior in efficiency to the face-to-face format, but simultaneously the given format may be more efficient than the remote implementation, with regard to well-organized process itself (e.g., with the application of the experimental model proposed);
- The current version of the experimental model is not without flaws that need to be improved further. There are: the time-related issues regarding the organization of the process in general, need to further optimization of the combination of synchronous and asynchronous interactions (such as length of phases, mostly related to issues of time-boundness), and the need to prove the model at the scale to a larger number of participants.

Thus, the average assessment of the effectiveness of the implementation of design thinking within the use of proposed model is 3.7 out of 5, from which it could be concluded that the model has potential to be applied, but it still needs to be improved. Also, it is clear to highlight the need to conduct more pilot launches, including ones with a change in such parameters as the number of participants, process length, as well as its application in the context of different industries to determine the level of effectiveness in tasks that might be affected by another industry specifics, etc.

E. Research limitations

Presumably, conducting an empirical study in a context of IT sphere related business environment may be considered as limitation of this study (meanwhile the given industry is not the target one and should be considered as one of the most interested in such research). Perhaps the result of the experiment may be influenced by the job specifics in this industry. Also, the sample could be wider in number of participants with aim to study much more broad experiences of a hybrid application of design thinking.

Simultaneously, the proposed hybrid model of design thinking is originally assumed to be universal as for specifics per other industries – to confirm this assumption of universality, it is necessary to conduct additional experiments in a business environment that does not connect to the IT industry.

IV. CONCLUSION

During the literature review a research gap regarding the process of innovation creation including use of particular approaches as the design thinking in post-covid was revealed. Assumed features of a hybrid mode's properties was formulated. It is also supposed that a design thinking model adapted to the hybrid mode's conditions should address as the features of this mode of labor organization as the key design qualities as the guarantee of obtaining the valuable results. A model that meets the highlighted requirements was proposed and proved within its pilot application in a business environment.

Within the empirical part of the given research a survey among IT industry experts on innovation creation in a hybrid mode of work was conducted. Also, an experiment to handle design thinking session in a hybrid mode of work with application of a proposed model was completed. As a result, this model could be considered as proven and may be exploited further, also there is a potential for its improvement, according to the feedback obtained via post-experiment interview of its participants.

It is also assumed that the given research direction has the potential to be developed further; some obvious at the moment directions of this study were revealed in the given paper.

REFERENCES

- [1] A. Belzunegui-Eraso, and A. Erro-Garcés, "Teleworking in the Context of the Covid-19 Crisis", *Sustainability*, vol. 12, May 2020, pp. 1-20.
- [2] A. de Lucas Ancillo, M. T. del Val Núñez, and S. G. Gavrilá, "Workplace change within the COVID-19 context: a grounded theory approach", *Economic Research-Ekonomska Istraživanja*, vol. 34, Dec 2020, pp. 2297-2316.
- [3] A.-L., Asikainen, and G. Mangiarotti, "Open innovation and growth in IT sector", *Service Business*, vol. 11, Mar 2017, pp. 45–68.
- [4] A. Ramani, "India's transforming post-pandemic workplace: The emerging role of the hybrid work model", *Corporate Real Estate Journal*, vol. 11, Dec 2021, pp. 186-192.
- [5] Boston Consulting Group, What 12,000 Employees Have to Say About the Future of Remote Work, Web: <https://www.bcg.com/publications/2020/valuable-productivity-gains-covid-19/>.
- [6] C. Kohls, "Hybrid Learning Spaces for Design Thinking", *Open Education Studies*, vol. 1, 2019, pp. 228-244.
- [7] C. Lattemann, D. Siemon, D. Dorawa, and B. Redlich, "Digitization of the design thinking process solving problems with geographically dispersed teams", in *Proc. Design, User Experience, and Usability: Theory, Methodology, and Management. DUXU 2017*, vol. 10288, May 2017, pp. 71–88.
- [8] D. Savić, "COVID-19 and work from home: digital transformation of the workforce", *The Grey Journal*, vol. 16, May 2020, pp. 101–104.
- [9] E. Yang, Y. Kim, and S. Hong, "Does working from home work? Experience of working from home and the value of hybrid workplace post-COVID-19", *Journal of Corporate Real Estate*, in press.
- [10] F. J. Petani, and J. Mengis, "Technology and the hybrid workplace: the affective living of IT-enabled space", *The International Journal of Human Resource Management*, in print.
- [11] F. Michelino, M. Caputo, A. Cammarano, and E. Lamberti, "Inbound and outbound open innovation: organization and performances", *Journal of Technology Management and Innovation*, vol. 3, Sep 2012, pp. 65-82.
- [12] J. Auernhammer, and R. Bernard, "The origin and evolution of Stanford University's design thinking: From product design to design thinking in innovation management.", *Journal of Product Innovation Management*, vol. 38, Aug 2021, pp. 623-644.
- [13] J. Potter, "Applying a Hybrid Model: Can It Enhance Student Learning Outcomes?", *Journal of Instructional Pedagogies*, vol. 17, Nov.2015, pp. 1-11.
- [14] L. Bader, A. Kruse, N. Dreßler, W. Müller, and M. Henninger, "Virtual design thinking - experiences from the transformation of design thinking to the virtual domain", in *Proc. ICERI2020*, Nov 2020, pp. 9091–9099.

- [15] L. Gratton, "Four Principles to Ensure Hybrid Work Is Productive Work", *MIT Sloan Management Review*, vol. 62, Dec 2020, pp. 11-16.
- [16] McKinsey & Company, Next Normal: When will the COVID-19 pandemic end? Web: <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/when-will-the-covid-19-pandemic-end>
- [17] McKinsey Global Institute, The future of work after Covid-19, a full report, Web: <https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19>.
- [18] McKinsey Global Institute, What's next for remote work: An analysis of 2,000 tasks, 800 jobs, and nine countries, Web: <https://www.mckinsey.com/featured-insights/future-of-work/whats-next-for-remote-work-an-analysis-of-2000-tasks-800-jobs-and-nine-countries>.
- [19] McKinsey Design, Design Thinking is Ready for Version 2.0, Web: <https://broadcast.mckinsey.com/79/5821/july-2021/design-thinking-is-ready-for-version-2.0.asp>.
- [20] M. Grzegorzczak, M. Mariniello, L. Nurski, and T. Schraepen, "Blending the physical and virtual: a hybrid model for the future of work", *Policy Contribution*, no. 14/21, Jul 2021, pp. 2-22.
- [21] M. Radonić, V. Vukmirović, and M. Milosavljević, "The Impact of Hybrid Workplace Models on Intangible Assets: The Case of an Emerging Country", *Amfiteatru Economic*, no. 58, pp. 770-786.
- [22] N. K. Hanna, "Assessing the digital economy: aims, frameworks, pilots, results, and lessons", *Journal of Innovation and Entrepreneurship*, vol. 9, Aug 2020, pp. 1-16.
- [23] N. Serbulova, T. Morgunova, and G. Persiyanova, "Innovations during COVID-19 pandemic: trends, technologies, prospects", in Proc. *Innovative Technologies in Science and Education. ITSE-2020*, vol 210, pp. 1-10.
- [24] R. Diab-Bahman, and A. Al-Enz, "The impact of COVID-19 pandemic on conventional work settings", *International Journal of Sociology and Social Policy*, Dec 2020, pp. 909-927.
- [25] R. Jolak, A. Wortmann, G. Liebel, E. Umuhoza, and M. R. Chaudron, "The design thinking of co-located vs. distributed software developers: distance strikes again!", in Proc. *The 15th International Conference on Global Software Engineering (ICGSE 2020)*, May 2020, pp. 106-116.
- [26] Stanford Engineering: Human Innovation Design, Current projects: Virtual Reality Simulation of High-growth Innovation Ecosystems, Web: <https://hid.stanford.edu/research/research-example>.
- [27] V. G. Konovalova, B. V. Petrenko, R. V. Aghgashyan, (2022) Choosing a Hybrid Work Model and New Challenges, in Proc. *the 2nd International Scientific Conference Smart Nations: Global Trends In The Digital Economy*, vol 397, in print.
- [28] Y. Bolshakova., V. Taratukhin, "The Main Models and Approaches in Creating of Innovations in the Post-COVID World in the Area of Information Technologies", in Proc. *Information Systems and Design. ICID 2021. Communications in Computer and Information Science*, vol 1539, pp. 52-65.