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Leveraging the Tech-savvy Next-generation Talents and Hackathon Techniques to Accelerate Digital Enterprise Journey and Space-related Endeavors

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Leveraging the tech-savvy next generation talents and hackathon techniques to accelerate the digital enterprise journey

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Abstract: This paper elaborates on the formats of situational and project-oriented education which, being embedded into university programs, enable senior technology and engineering students to develop design, project and entrepreneurial skills while working on real-life innovation challenges formulated by an industry partner. A non-exhaustive list of the mentioned formats is set out in the form of a conceptual model that describes an enterprise innovation process extended by the inclusion of academic thought-leadership and tech-savvy students' insights into new products, services and business models development. Having completed a series of industry-supported hackathons and design-thinking workshops, the authors provide an explicit description of use-case scenarios, key success factors, and implications for applying the proposed model. The paper conclusion offers a list of benefits for using the model and further insights into setting up and running academia-business collaborations aimed at innovation design and applied research rather than skills development.

1. Introduction

With an apparently increasing number of natural disasters (earthquakes, tsunamis, volcanic eruptions mass movements, floods, and storms, etc.) taking place worldwide, an urgent question about how best to prevent a rise in the number of victims has become a global concern. A poor political and social state of affairs, such as a low educational level in a population or unsatisfactory medical care, can lead to additional human-made hazards, for example famine, displaced populations, industrial or transport accidents, which then aggravate pre-existing problems.

Seeking to address the issue of naturally-occurring and human-made disasters as problems with very severe consequences, SAP University Alliances/Next-Gen [1] organized a hackathon for students from engineering and humanities to encourage them to contribute to the problem resolution. This hackathon took place in Divnomorskoye, Russian Federation, from the 2nd to 3rd of September 2017 and hosted 19 students from eight Russian universities and one German university. The full-schedule, two-day program started with an overview of existing space remote-sensing methods with the help of keynote lectures from two leading scientific and educational institutions - the Russian Academy of Sciences Institute for Biomedical Problems (IMBP) (Russian Federation) and the International Space

University (France). The implementation of space technologies into the solution prototyping process was crucial during the hackathon for reasons explained in Section 2. The methodological approach used in the hackathon was Design Thinking. This was introduced to the students by the SAP University Alliances/Next-Gen team. Design Thinking is a methodology that aims at creating innovative ideas that solve defined customer problems, and therefore takes into account the customer's needs and expectations throughout the whole product development life cycle [2] [3]. Furthermore, the SAP University Alliances/Next-Gen team acted as facilitators to guide the participating students through all the steps of the Design Thinking methodology during the two-day InnoJam and Bootcamp (referred to as a Hackathon). Thirdly, expert technical support on the SAP Cloud Platform - a cloud-based infrastructure to create technical prototypes of proposed solutions - was provided to the students. The hackathon participants were also granted access to SAP Jam, a private communication platform, to interact remotely with off-site SAP experts and exchange documents (downloading tutorials and uploading intermediate and final deliverables).

Student teams enrolled for the hackathon were offered the opportunity to elaborate on real-life challenges while being supported by experts both technically and content-wise. Mixed competency groups allowed for a 360 degree-view of the challenge and ensured solutions that were both more holistic and interdisciplinary. The team project results were then evaluated by the jury committee composed of university and industry representatives.

2. Space Technology for Prevention of Natural Disasters and Risk Management

The application of space technologies to anticipate both naturally-occurring and human-made disasters and to implement appropriate risk management serves as a powerful method to address the geographical regions which are most frequently affected. Consequently, the aforesaid high-risk regions should benefit significantly from technologies such as Earth observation, satellite-based telecommunication, global navigation satellite systems, and so forth. By providing the local population in danger regions with space-based information, one can mitigate catastrophic outcomes caused by naturally-occurring and human-made disasters.

The idea of making the data public and easily accessible is not new and it is implemented quite commonly. Accordingly, there is a free of charge, open platform provided by the United Nations Office for Outer Space Affairs, namely the United Nations Office for Disaster Risk Reduction (UN-SPIDER's Knowledge Portal [4]) website. Though this data can be used by everyone worldwide, there are some difficulties with accessing and interpreting it, especially when one is an actively dangerous situation.

There can be many factors that negatively impact user ability to understand and apply the data. However, the two main ones are:

- abundance of technical information but with no guidelines for situational behavior
- applications that cover limited areas and are situation-specific

As can be concluded, there is a clear need for engineering and design solutions to mitigate these issues. This need laid the foundation for the hackathon and the two case studies that were generated for the students to address and solve.

3. Hackathon design

3.1. Organizers, partners, and support

The hackathon was organized by the SAP University Alliances/Next-Gen team, CIS and DACH regions, partnering the International Space University, France, and the Russian Academy of Sciences Institute for Biomedical Problems, Russian Federation.

Prior to the main technological part of the hackathon, since they were new to the subject, the students were introduced to the essentials of the space-based technologies. Hence, remote keynote lectures were given by two professors from the scientific institutions focusing on space related research – Prof. Chris Welch (Astronautics and Space Engineering at the International Space University, France) and Prof. Dr. (M.D.) Vadim Gushin (Psychological department at the Russian Academy of Sciences Institute for Biomedical Problems, Russian Federation). Furthermore, Prof. Welch and Prof. Dr. (M.D.) Gushin assisted the students from an expert point of view during the hackathon.

The students could also access technical assistance provided by Yulia Yadgarova, Ph.D. candidate at Bauman Moscow State University. The aspect covered by the technical support team was the services of the SAP Cloud Platform.

3.2. Case studies and challenges

The students were offered two challenges that they could provide a solution for. Each of the two was a natural disaster situation with local population endangered due to the accident. The challenges also briefly defined the situational and environmental contexts. Another case study had no exact description of the disaster situation and could be elaborated by the students themselves.

Below there is an outline of the case studies which were offered to the students. The copyright holder of the studies is NASA (National Aeronautics and Space Administration) Space Apps Challenge 2017 [5]:

Case study 1: **"***Water, water everywhere!* [6]

Challenge:

Develop a tool that provides emergency management personnel with an up-to-date flood-risk map for an area of interest.

Background:

Flooding is a pervasive natural hazard with devastating consequences on people's lives, homes, and livelihoods. Mapping floodwater extent for active floods is critical for local and regional officials, and also for disaster relief workers who are trying to determine where to focus their efforts. Additionally, it can be critical to monitor vulnerable regions for water pollution, or the spread of water-borne illnesses, like cholera.

Your challenge is to develop an app that displays an up-to-date flood-risk map for an area of interest and is easy for the public to use and understand. The ideal solution should be general enough to be applied to any area worldwide for which sufficient relevant data are available.

Considerations:

Consider combining satellite, airborne, in situ and/or simulation data from different sources. These may include:

- *Meteorological/rain forecasts*
- *Geological and geometric characteristics of the terrain*
- *Soil moisture content […]"*

Case study 2: "And YOU can Help Fight Fires! [7]

Challenge:

Build a fire-monitoring and crowdsourcing tool that will allow local fire managers to respond to wildfires.

Background:

Fires are increasing across landscapes throughout the world due to increased drought, increased temperatures, and human-driven changes (e.g., deforestation When the weather is extreme, the fires are extreme, often spreading beyond countries' abilities to fight them. Fires can move quickly though landscapes and communities, causing immediate damage and extreme health risks due to smoke pollution.

Often, fires are so big that it is impossible to: (1) see the best paths out; (2) see the best paths available for rescue or fire management vehicles to enter; and (3) estimate where post-fire effects will be the strongest (debris flows, landslides). However, satellite data can see the entire landscape and help with valuable information for those who need it most!

Develop a tool that combines satellite data with crowd-sourced data from people on the ground near areas of concern, to help firefighters identify:

- Where a fire has started
- *Where a fire is spreading or might spread*
- *Best paths for rescue and fire management teams to enter and navigate the areas of concern, [...]"*

Case study 3: "Bring Your Own Solution [8]

Challenge:

Follow your brain and heart, present a solution of your own choosing!

Background:

Do you have an idea that doesn't fit any of other challenges? This is the place for your decision, whether you want to design and develop a tool, create data visualization, hack on an Arduino... or anything else you can think of! [...]"

3.3. Design Thinking methodology

The techniques of Design Thinking methodology were used to manage the process of challenge analysis, idea generation and solution prototype development within the hackathon. In that context, Design Thinking represents a means of investigation that relies heavily on brainstorming and acts as an innovative design and development methodology that aims to deliver creative and user-centered solutions for a given problem in a structured fashion. It follows six iterative stages (see Fig. 1 below): (1) get an understanding of the problem; (2) observe users' behavior; (3) interpret the empirical observations; (4) generate ideas to solve the problem taking into consideration actual user's behavior; (5) build a prototype; and (6) test the prototype [2].

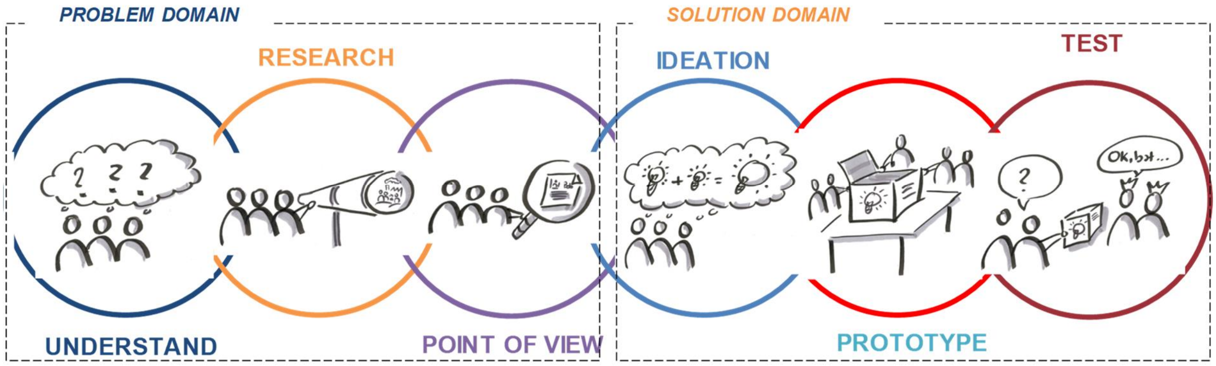

Fig. 1: The Six Design Thinking Stages

The first three stages form the «problem domain», whereas the latter three represent the «solution domain».

Spending a significant amount of time on problem analysis, identifying potential users and getting insights about their relevant needs, allows the participants of Design Thinking sessions to avoid a commonly encountered issue of «jumping to the solution» which is often the reason behind many product launch failures [9]. By the end of the third stage of the «problem domain», participants have developed an actionable problem statement - point of view.

Ideation, the first stage of the «solution domain», is a step which focuses on the idea of generation in terms of concepts and outcomes and is aimed at exploration of a large quantity of ideas and of diversity among those ideas [9]. During prototyping the ideas and explorations are taken out of heads and into the physical world – the more artistic the prototypes are, the more feedback (both negative and positive is collected) on these, the better. The sixth stage is testing, but is not usually the last one, since testing is an iterative process that initiates the creation of the next version of the prototype, which represents an opportunity to refine solutions and learn more about users [10].

Fig. 2: Hackathon participants during Design Thinking session

3.4. Participants

The hackathon was attended by ten Bachelor students, seven Master students, and two Ph.D. students. The participants built up three teams, each with students from different disciplines but with the majority of them from engineering sciences; two out of three groups were multicultural because one of two German students was a team member in each of them respectively.

3.5. Jury and assessment

The student teams chose one case study to work on and build a conceptual and technical prototype for. The prototypes were presented to the jury in the final stage of the hackathon. The jury committee were experts from industry and academia. The criteria they used to assess the presented solutions were as follows:

- Relevance to the stated in the challenge problem:

  How does the solution match to what is stated in the challenge description and what was discovered during the interaction with experts and to other collected insights?
- Originality of the proposed solution:

  How different is the proposed solution from the existing approaches to the stated problem?
- Feasibility of the proposed solution:

How much effort will be required to create a fully-functional product out of the proposed prototype? Does the concept fit into existing global socio-economic context and technological infrastructure?

- Functionality of the technical prototype:

  Sufficiency of the set of functions to give the main idea of the service/product offered as the result of the team project. What portion of the final product functionality is available in the prototype demonstrated to the jury on the final stage?

Fig.3: Prototype presentation

3.6. Hackathon results

In course of the hackathon the students created three prototypes: iEvacuate, Fire Control, and WWE Application. In the following, each of the prototypes will be briefly presented. For this, excerpts from the students' final presentations will be employed:

- Team 1: iEvacuate uses historical and live data aggregation and analysis, applying AI along with real-time monitoring of areas affected by fire. iEvacuate estimates fire rank, a direction of future fire spread, needed amount of resources, optimal evacuation routes, and estimated rescue time. The app shows similar cases of wildfires in the past and their consequences by providing maximum usability.

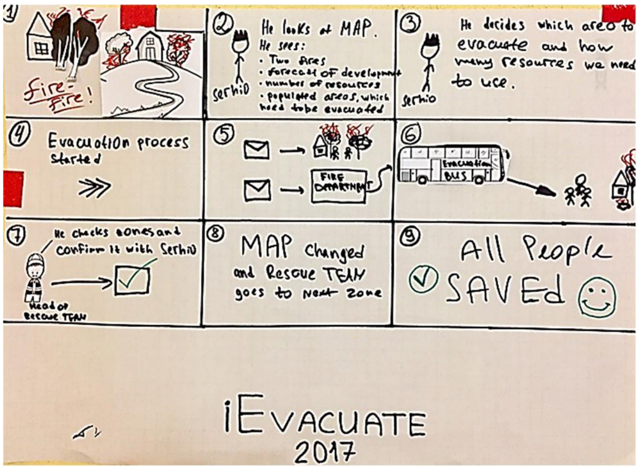

Fig. 4 : iEvacuate prototype

- Team 2 (the winning team): Fire Control integrates data from different sources, such as satellites, app users, smart sensors, drones, and situation center to achieve visualization of integrated data. The app is built on a six stage-process: sending a signal, receiving real-time information, getting instructions, getting visualized data, getting directions to a safe place, finding the safe place.

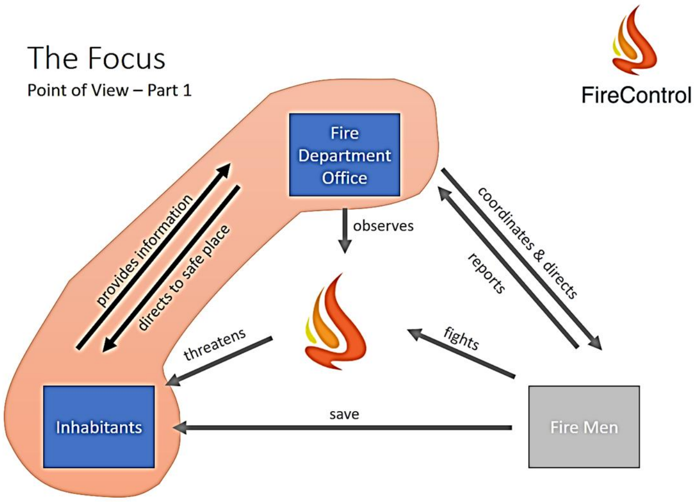

Fig. 5: Fire Control – POV. Slide

- Team 3: WWE Application forecasts flooding cycles which enables rescue teams to inform and save people. The app analyzes historical data, implements Internet of Things equipment for level of water monitoring, applies data from drones, and data regarding seismic activity obtained from satellites. The app provides an opportunity for people to connect to rescue teams and send location marks.

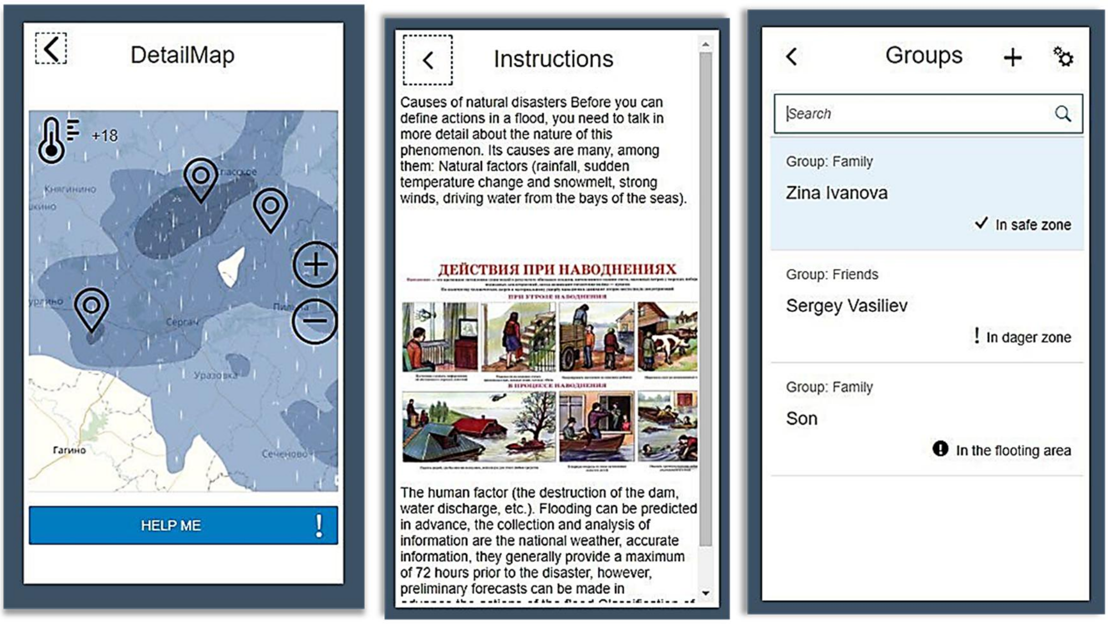

Fig. 6: WWE Application – App Concept

4. Conclusions and future work

The hackathon allows the participating students to apply their academic knowledge and personal aspiration to tackle real-life challenges. The hackathon became a platform for realization and fostering students' potential. The unique possibility to work jointly with other engineering and humanities students was of both educational advantage and benefit for personal development. This practice shows that working on real-life challenges in diverse teams under time pressure brings about quite original solutions which should be of great interest for industry and academia.

The key factors identified for the success of such endeavors as the hackathon and using it both for educational and industry innovation purposes include:

- Clearly stated and thought-through challenge statements
- Involvement of the respective experts and challenge owners throughout the event
- Students with diverse educational backgrounds, and holistic view of the challenge, and the ability to handle complexity
- Properly arranged space of the venue
- Properly moderated process of brain-storming (Design Thinking as one of them)
- Available technical infrastructure for effective document exchange and prototype creation
- Explicitly stated criteria for the final assessment of the deliverables by the jury

In the very near future, SAP University Alliances/Next-Gen plans to organize further hackathons on different topics to help young talents enrich their theoretical education with practical experience.

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