Fachhochschule Dortmund

University of Applied Sciences and Arts

IDiAL Institut für die Digitalisierung von Arbeits- und Lebenswelten

Dortmund International Research Conference 2019

CONFERENCE PROCEEDINGS – 28-29 JUNE 2019

- Project Management
- Leadership and Sustainability
- Digital Transformation
- ICT, Embedded Systems and Technology
- Education and Learning

International Research Conference in Dortmund 2019

The International Research Conference (IRC) at the Dortmund University of Applied Sciences and Arts took place for the tenth time on June 28th - June 29th 2019.

All information about the conference can be found on https://go-study-europe.de/do-irc-sus/

This year the conference was celebrating its first big anniversary – 10 years. The Dortmund IRC was supported by the DAAD Strategic Partnership "European Partnership for Project and Innovation Management (EuroPIM)", which was also celebrating its 5 years-anniversary. Master and PhD students, lecturers and researchers had the opportunity to present and discuss their current research work and projects in the plenum. The concept offered young researchers a platform where they could test themselves in a scientific discourse. Guests from partner universities in Bilbao, Leuven, Kaunas, Trondheim, Kiev, Ternopil, Zaporoshje, Astana, Almaty, as well as from the Netherlands, Pakistan, Palestine, and other countries were participating again this year. With its aim to form a forum for meeting, presenting new research results and thoughts, and discussing future research and cooperation projects, the conference has turned into one of the central academic events for the EuroPIM consortium.

The conference covered a wide range of topics going beyond project management and covering digital transformation, emerging technologies, handling of competences and knowledge, trends in higher education, as well as sustainable project management taking the environment into account. The special quality of the research is its transdisciplinary and applied character. Many contributions show results from cooperation with industry and society.

The two-day conference offered sessions on Project Management, Leadership and Sustainability, Digital Transformation, and ICT. Lecturers from Mexico and Chile also joined this year and were involved both at the Dortmund IRC and the Dortmund International Summer School.

The Dortmund IRC, which took place for the first time in 2010, follows the spirit of its founder, our honoured and very much missed teacher and friend, Prof. Dr. Dr. h.c. mult. Peter A. Reusch[†2016].

A special thank you goes to the organizing team, headed by Clara Decelis Grewe, with the EuroPIM team, the student support team, and all the active and supportive members of the team & IRC family.

For the 5th time, the conference was followed by the Dortmund International Summer School, from 1st to 5th of July 2019. It took some of the topics of the conference and developed them further into new results and new teaching modules. The Summer School was organized into the following five streams:

- Automotive Software Engineering (Robert Höttger, Carsten Wolff)
- Digital Marketing (Elena Vitkauskaite, Wojciech Czart)
- Digital Systems (Ingo Kunold, Jörg Bauer)
- Quality and Sustainability in Project Management (José Ramón Otegi Olaso)
- International PhD Summer School (Ala Nuseibah)

In 2019 the conference had seven sessions, covered on two days:

Friday, June 28th:

Session on Leadership and Sustainability (José Ramón Otegi Olaso)

- If We Were the Rulers of The World. Part I: Reasons for The Biggest Project Ever: Protecting the World against Us (Werner Wetekamp)
- Role of Project Manager's Ethical Leadership on Project Team's Absorptive Capacity in IT Projects (Rao Aamir Ali Khan and Muhammad Naeem Khan)
- Role of Empathy, Emotional Intelligence, Transformational Leadership of The Project Success (Nadiia Rusan, Boris Kozyr, Sergey Bushuyev and Alina Zaprivoda)
- Successful Governance of Projects from The Perspective of Virtual Teams (Katalin Szász and Bjørn Otto Elvenes)
- Domains of The Project Matrix Organisational Structures in The Public Sector (Emils Pulmanis)

Session on Digital Transformation, Part 1 (Ala Nuseibah)

- Agile Transformation in Large International Project-Oriented Companies (Olha Mikhieieva)
- Managing the Digital Transformation: Assessment of Key Capabilities Used to Drive the Digital Transformation of Well-Established Organizations (Katia Sofia Jimenez Agurto and Ala Nuseibah)
- Blended Learning in The Context of Project Management: Foreign Language Competence Acquisition (Yelena Dyan and Nargiza Mikhridinova)

Poster Session & Exhibition

- Digital Virtualised Environment for Teaching and Testing at Dortmund University of Applied Science and Arts (Fridtjof Mund, Pascal Proske and Stephan Recker)
- Ruhr Master School: future perspectives (Thorsten Ruben)

Saturday, June 29th:

Session on Digital Transformation, Part 2 (Anatoly Sachenko)

- Managing Digital Transformation in Kazakhstan: New Challenges of Digital Era (Azimbek Omar and Yerlan Shildibekov)
- Competences Management for The Digital Transformation: Framework to Adapt Usability of The Assessment Tool (Nargiza Mikhridinova)
- Hybrid Project Management Methodology for R&D, Innovation and R&D&I Projects in CFAA (Mahboobeh Ramezani Farokhad, Leonardo Sastoque Pinilla, Nerea Toledo Gandarias and Luis Norberto López de Lacalle)
- Developing A Practical Framework to Manage Hybrid-Agile Projects for Companies with A Traditional Project Management Approach (Iuliia Shkalikova)

Session on Project Management, Part 1 (Sergey Bushuyev)

- Projects in Smart Cities (Beverly Pasian)
- Ways of IT Projects Timely Implementation (Pavlo Bohach, Sachenko Anatoly and Dombrowski Zbyshek)
- Building Project Management: Organizational and Technological Bases of Estimation Effectiveness of Project for Renovation of Unfinished-Construction (Tetiana Lukianova and Vasul Donenko)

Session on Project Management, Part 2 (Christian Reimann)

- Advancing Organizational Culture of Project Management (Olena Verenych, Viktoria Bushuieva, Denys Bushuiev and Olena Sharovara)
- Resources Management of Projects Portfolio in 4P-Environment (Nataliia Yehorchenkova, Oleksii Yehorchenkov, Yevheniia Kataieva and Ivan Oberemok)
- Important Principles That Need to Be Taken into Account during Step by Step Business Process Automation (Olena Shpylova)

Session on ICT (Carsten Wolff)

- Exploring the Integration of LoRa and Wi-Fi Technologies For Smart Grid Applications (Maysaa Salaheldin, Areen Faqeeh, Manar Faqeeh, Abdalkarim Awad and Iyad Tumar)
- RISC-V Processor with Configurable Pipeline Stage Placement (Igor Khimchenko, Christian Klarhorst and Peter Schulz)
- Interactive Educational Environment for Kids Universities Based on Raspberry Pi (Tatiana Horelikova, Peter Arras and Galyna Tabunshchyk)
- Investigation of The Methods of Addressing the Elements of The Matrix in The Dynamic Display of Graphic Objects (Andrii Kanovskyi, Anatoly Sachenko, Volodymyr Kochan and Dmytro Kostiuk)

We say thank you to all authors for the contributions to the Dortmund International Research Conference 2019. The contributions are important – as well as the discussions – for the evolution of the community and the growing power to meet the requirements of the future.

Greetings from the flow of strong projects

Clara Decelis Grewe, Christian Reimann, Thorsten Ruben, Carsten Wolff & Team

Table of Content

IF WE WERE THE RULERS OF THE WORLD.
PART I: REASONS FOR THE BIGGEST PROJECT EVER: PROTECTING THE WORLD AGAINST US

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Abstract: *This assignment is part 1 of 4 articles which have the target to show a direction how, who and in which areas we should protect the world. Nowadays we ignore that we destroy and destroyed our world in these decades of the last 200 years. "The world was empty before – now it is full", states the Club of Rome because the overpopulation leads to many problems. Why do we not act although we have to act? This article "Part 1" shows 12 reasons why we solidify in motionlessness. Then the 6 largest and most obvious areas of "action needed to protect the world" are mentioned such as overpopulation, deforestation and pollution of the oceans.*
Part II of this line of articles deals with the areas we have to care about on global level. Part III shows the leading rules how to manage such a project to save the world. Part VI shows how this project really can start and who can and should initiate it in which way.

Keywords: protection of the world, environmental protection, climate change, overpopulation, deforesting, pollution

1. Introduction

If we were the rulers of the world... What would we all be able to do then? Enjoy, save and bring peace to the world for example. But are we not the rulers? Have we not assumed power over land and water, beast and man? Yes! Of course!

The purpose for writing about this is precisely the following point: we must understand that we hold the world in our hands - and therefore have the sole and immeasurably great responsibility for our actions in the world and must cease to exploit it. So, what should be done? As always, when problems are to be solved, this means that we must sharpen our eyesight, analyze, plan and implement plans.

In this first part of four we will just show that things have to be done. Although there are no additional proves needed, we show that we cannot escape from this task and we should not wait for god or an uprising of animals. The main content of part 1 of the 4 articles is to show why we don't act and why we should act. A main part is that we have an organization of the world which fitted to the past but not to the current situation where the nations and their legislations and executions are no longer able to manage their topics because they are not national but global topics.

2. The initiation of the most important project of the world "protecting the world against us" and their reasons

In this article we show that
- The most important project of the world is to protect our world.
- We cannot expect help from others like us. We as human being have to do the changes.
- Do we understand that we have to act?
- Are we already doing enough?

- Why we don't act?
- In which area it is visible for all that we have to act?

2.1 The most important project of the world is to protect our world

I claim that the issue being addressed here is entirely the most important one. It is about the greatest thing that we as people can influence: the world and its protection and salvation. The world is far more important than we as individuals, as an animal species, a country, a scientific subject, an invention, a biography or as a beautiful story. This is the most important issue because it is about saving the only planet we have: The Earth. We have to deal with how to save it and who can save it, so that those generations that come after us can still inhabit an Earth worth living on.

2.2 Who has to act?

The present world is divided among people for its resources, land, legal areas, and even those who have played the role of 'opponents' in this round of world rulers, are also people who are committed to environmental protection or biodiversity. We have long since conquered the animals as possible competitors for the control of the earth.

Who could dispute our leadership role? Hardly anybody would question that neither a deity nor an extra-terrestrial being, if such existed, could have the influence that man currently has in our world. No matter where you look, the influence of man is clearly visible. Man undoubtedly dominates the world, and more or less comprehensively. We have to act. We will come back to this question in part IV of this line of articles.

2.3 Do we understand that we have to act?

We all know that we have to act – if you as a reader look to yourself you know that we have to act. But why don't we change the situation? We do not feel strong enough as a single person. But why do political parties not overtake this role? Because there are other man-oriented topics which are more important. Unemployed people vote for better job, pensioners vote for save pensions funds and students for peace and good education and British people for or against Brexit. All these topics are important. But will we have a nice planet in 1000 years to enjoy all this in future? The green parties of the world get 5 or 10 % of votes and so the green parties reduce their "green" direction based on the missing support for their topics of the people – people prefer to hear about immigration, employment data protection, tax reduction or digitalization.

2.4 Are we already doing enough?

There are already many plans to protect the world; politicians discuss them, and others are implementing initiatives of various kinds. But it cannot be done with mere fig leaf measures or those which are only partial or are regionally limited.
Energy saving already plays an important role for example in Germany, whether it's in the private sector when choosing a light source or with road traffic by introducing cars which stop the engine at the traffic light. Of course, it's good to use energy sparingly, although the effects of such measures are hardly noticeable. However, the exaltation energy savers have can be enormous. At the end of each legislative period, policy makers also always reach their energy-saving targets.

But in fact, this means that the demand for correct, fully effective measures remains on a too low level, just as their implementation does. The energy supply would last only a little longer because of energy-saving, while the energy reserves will melt away to nothing in e.g. 504 years instead of e.g. 500, just as it is happening with the ice at the poles. Energy saving is certainly a laudable

idea, but unfortunately leads to the opposite of the desired outcome. Energy saving simply prevents a real, effective and sustainable energy turnaround from being put into effect. This will be described in the next chapter.

2.5 Why don't we act?

Do we sleep not knowing about the problems we have already now here on our world? Do we have not enough ideas to protect the world? No: the concepts are easy (don't throw waste to a river or don't cut off the rain forest) or they are complex but, in this case, already invented (energy from the desert, recycling of waste or anticonception). But why we do not act? I think there are two groups of reasons for this: one group (the following positions A) till I) of reason where we will have problems to change the nature of our characters and the second group which contains three position (J till L) where I see the possibility to change and to start an initiation.

A) Positive and negative Cognitions
A student at the University of Applied Sciences, Dortmund, has written about these points in his thesis and notes that there is an interest in taking steps of energy saving and also real steps can be observed. But they are only minimal steps really, which above all soothe and prevent real concern or further reflection on the needed facts in question. This student brings up Leon Festinger's cognitive dissonance theory in order to explain that with simultaneous awareness of the problem as such, there is an effort toward self-pacification. According to this theory, different directions/ desires/ behaviors/ problems/ decisions (so-called cognitions) are attempted to find a solution for concrete action. These relationships between different alternatives can be dissonances or consonances. Consonances are positive conditional cognitions (e.g., I want to get fresh air and have to go shopping anyway). Dissonances are negative cognitions which influence one another, such as "I want to eat chips" (delicious) or "I would rather not" (I'll become fat). The more significant the cognitions are, the higher the dissonance.

One can observe that man tries to gain a balance in such trade-offs, for example, by referring to the rich nutrient content of beer (positive cognition is added), or to the fact that the renouncement of beer leads to fewer friends (subtraction of dissonant cognitions) or that consumption of beer does not directly lead to an increase in weight, but rather one may even help to protect the rainforest by this action as mentioned in a German beer marketing campaign (substitution of dissonant for consonant cognitions).

This theory applied to energy saving means that the attitude of the human being is roughly conceivable as: "On the one hand I need energy (heating, car, electricity ...), but on the other hand, I destroy the environment. If I need a car now and own it, but it turns off automatically at the traffic lights, then I am, despite everything, a good citizen and an energy saver. When I use energy saving lamps in addition, I have done everything I need to; especially when I see that my country produces a lot of renewable energy. Here everything is clean. This is supported by politics and the economy. Summarizing this in one sentence: the practice of energy saving hinders the search for a better energy supply. It acts as a positive cognition and leads us to continue emitting CO2 year after year. We can apply this example of energy saving to all other areas of mistakes we do currently in relation to your world. We build a new house and close 500 m³ of land with the house but put a modern bird feeder to the garden and think we did all we can. We separate all the waste of our house and think that we should be proud on it already.

B) Only a few people are future oriented
People are oriented in solving their problems. Young people care a lot about games and solve their problems with friends, Old people care about health and trips, families have to care about their children and their existence. Do we have a minister for future? Does someone think regularly about what will happen with the world in 200 years or in 1000 years? Are our children more

important than our great-grandchildren? How high is the percentage of our income we pay for decisions of the past (credits?) or we do invest in future?

C) We are one of 7 650 000 000 people on this planet
We are not important or strong enough to change the world. If we act alone the effect is like a drop in the ocean.

D)   In relation to others we do a lot
We care already about protecting animals in Germany and our rate of renewable Electricity is around one third which is very high in relation to other states. So, let the others do something now – let Brazil stop cutting down the rain forest and let China stop the pollution of the air. But we forgot that Germany was one forest 2000 years ago and 100 years ago the sky in Dortmund was dark and gray even when the sun was shining. But let the others do something now.

E)   We do not suffer enough
Al Gore stated in his speech in front of managers and politicians in Poland 2010 that we tend to change the things only if we are in real danger. He painted the picture of a bathtub with us in it and water getting hotter and hotter. When will we get out? Only if it really hurts, we jump out of it. In these days the radio station like to report about nice weather, and we like to eat ice-cream even in autumn and spring because of the advantages of the climate change. Let's stay in the water till we get burned.

F)   We are concentrated on mankind
Only nerds care all their lives about birds and the protection of the ocean. Those of us who care about their children, our rights and our religion are normal and accepted.

G)   A change to protect the world costs too much
Air is for free: would you like to pay for it? Land is limited: the price would increase if you reserve land for animals. We know that renewable energy costs more than to drill a hole to the ground and pump Oil out of it and burn it.

H)   Only a few people vote "green"
If you want to lose the next election as a politician write to your flyer that you want to reduce the number of people in the country and half of your country should be given back to nature. Add that according to your new ideas in 20 years no more oil, gas and coal should be uses! Look how many people will vote for you. The green party in Germany gets between 5 and 10 percent. I do not expect the number of voters "for the future and for plants and animals" to be higher than this.

I)   We are not concerned
Why should we care about the problems of the Maldives or the North Pole which will not exist any longer, but we will not be erased from the landscape? If we move our waste by ships to Africa and our country is clean why to complain? Our character is dedicated and conditioned to help our children, family or friends first. And because of the shortage of time and money there are not enough resources left to care about others. Do we expect that the people starving with their families, finish cutting off the rain forest? And the rainforest is far away.

J)   The political cycles are too short
Although 4 or 5 years between two elections are a long time, the politicians have no opportunity to care about sustainability because sustainability costs money – gathered by taxes of the voters. And because the voters will see no direct impact of this sustainable activity, they will vote next time for those who promise short term items like increase of the promotion of students or the governmental aid of children or the increase of pensions.

K)   There are no members of parliaments who care about the rights of plants and animals
This reason why we are not acting is the most important one I want to add here. It has from my point of view another character than the others because understanding about this point is a promising key to success – a reason that we might change (while we will never change that people are egoistic and selfish because this is our nature). Before I will come to the core of my message I would like to start earlier:

Thousands of years ago (Phase 1), there were only single tribes of people who neither had an understanding of the concept "world", nor did they need it. These tribes lived in their own territories and defended against other hostile tribes.

Phase 1: Tribes live side by side in territories without state leadership

States slowly formed from the peaceful union of tribes as well as the hostile subjugation of neighbors. State formations of different tribes grew (Phase 2). The states organized themselves within the borders, defended themselves externally, or tried to expand militarily or through alliances. Finally, the entire world was divided into countries led by kings and tribal chieftains. Through wars and colonialism, the boundaries only shifted - the system as such remained.

Phase 2: The entire world is divided into countries with borders, and the countries are run by individuals

After phase 2 all further states are distinguished only by the change in the leader. Whether or not the country's borders are shifted does not matter. After many centuries, democratization began because large numbers of subjected people surrendered to the small number of persons/families with leadership privileges. Many states have not yet been affected by democratization, but I think we can call it a "natural law" that all members of a country also play an active part to some extent in the direction of the state. The first form of democracy - this aspect will play a role in the further progression of this discussion - were the democracies supported by the males of the country.

Phase 3: The countries are (largely) transformed into democracies, led by the males of the country

A further generally observed development (Phase 4) was that women had now begun to take part in parliaments. After the formerly enslaved men of the country were able to vote, women also had risen and the way to participation in parliaments had been opened for them too.

Phase 4: Women enter the parliaments of democracies on an equal basis

So we can observe that in most of the developed countries we have democracies in place based on the full human power of women and men. Animals and plants have no voice in the parliament. Instead of an uprising of animals and plants they tend to die out if they get in trouble. The missing voice is why their rights are misused and do not become known. This is one of the two organizational reasons why the world cannot heal itself: The power of politics is focused on human being.

L)   There is no organization which takes the responsibility to change the world to a better one

This reason begins with the same fundament as the previous one because the same roots are lying in the time when mankind was in line with nature and the world was still empty. So, we repeat the first two phases from K) and go after this to another direction:

Phase 1: Tribes live side by side in territories without state leadership

Phase 2: The entire world is divided into countries with borders, and the countries are run by individuals

Phase 1 and 2 show that the organizational structure of the world was growing. Tribes didn't need countries but only their territories to hunt and pick fruits and they didn't touch the territories of other tribes. After the growths of number of inhabitants there were fights for territories and the organizational solution of countries appeared. The borders were protected – within the border the people felt like one team/nation – the nation organized common needs as one community like roads and armies – they introduced taxes and leaders of a nation. The organizational need and sense of nations is obvious: to work together, to protect themselves and to develop together. But again the situation had changed. The world is full of people now. We cause problems for the whole world or let's put it to different words: we as one nation cause problems for the other countries. Problems like pollution, climate change and attacking other nations getting global while our organization stayed on the level of organization we have from 'Phase 2': nations.
The headline of this chapter is "Why we don't act?". The reason for not acting I give here in L) is: because nobody has the responsibility! Some take the responsibility sometimes (e.g. US helped Europe against Hitler-Germany) but voluntarily and only on demand and not with the higher target to care in all dimensions about our world. So the reason why we don't act is: there is nobody who has to act.

In part 4 of this series of articles I will start with this organizational deficit because this to understand is the key to success.

2.6 In which area it is visible for all that we have to act?

We all know that the world is not the one we know from our childhood. Only 0,4% of the German territory remained natural and untouched. But is the change a good one or neutral or negative? In the following 6 parts of chapter 2.6 I want to show just a few areas of change. The readers can evaluate the direction of this change (positive or negative) on their own.

A)   Reduction of Insects
The University of Göttingen and the "Entomologischer Verein Krefeld" found out in independent investigations of a long term study that the insects in Germany were reduced in the last 25-30 years around 77-80%. The University of Queensland published in the beginning of 2019 that in 100 years all insects will have gone from our world if we continue in this way. Moreover there are so many problems connected to this even for mankind that we might follow this extinction of the insects. There were no similar scientific works 100 or 200 years ago, but I strongly believe that the starting point 1989 of "Entomologischer Verein Krefeld" is already after an enormous reduction before 1989. From this point 30 years ago 20 % of insects are only left. Don't we have to do something?

B)   Reduction of the Richness of Species
The United Nations started in 2011 the 2011 2020 United Nations Decade on Biodiversity. They claim that during every day 130 species of animals or plants die out forever. The human being has a comparable result on the extinction of species as the large meteor impact of 65 million years ago. I started my activity to try to protect the world after a report of "Tagesschau" in the German

TV, that the Yangtze-Dolphin died out forever and two excursions in 2006 and 2007 to find this dolphin were not successful. Sadness remains and motivation.

C)   Pollution of the Oceans

In these days we hear a lot about plastic waste in the ocean. We produce 250 Million tons of plastic worldwide in one year. It includes around one trillion plastic bags that need between 100 and 500 years to come undone. If we extrapolate the weight of plastic going year by year to the ocean and if we extrapolate the weight of fish in all oceans in the same way: in 2050 there will be more plastic in the ocean than fish.

But the pollution is divers. The Baltic Sea is by far the most polluted sea of the world. Because of the fact that this sea has only a small recirculation of water because of the small corridors to the big oceans, the water of the whole Baltic sea will be completely changed only every 50 years. And a lot of rivers from European countries end in the Baltic Sea. 25% of the ground of the Baltic Sea is already dead.

D)   Deforestation

Since 1990 until 2015 the area of forest was manly reduced in South America and Africa. In these 25 years 195 Million ha or 1.95 km² were deforested. This is 5.5 times the area of Germany or it equals the size of Mexico. The deserts are growing. If we don't stop deforesting the forest will have gone completely in 750 years. 750 years sound a lot for us, but in the time of the existence of forests with around 400 Mio years we might extinguish the forest in a timeframe of 0,000002 % of the time the forests exists.

E)   Climate Change

This area is the best known and most discussed area of all. But still we are not acting consequently. The main reason is the burning of CO_2-based material which was inclosed for millions of years to the crust of the earth and which we dig and pump now out of it within a few centuries or even decades and burn it. We are able to invent computers and we can fly to the moon but we still pump oil out of the earth like 100 years ago and burn it. If we don't stop this, the living conditions of all being on this planet will change dramatically within the next centuries. Melting ice can increase the sea level by 65 meters. On the other hand we will have less fresh water. The streams of the oceans will change, the deserts will grow, the weather will get more powerful and we will have more storms, the bio diversity will shrink and a lot of detailed regions will die like Amazonas forest or all the reefs in the oceans.

F)   Overpopulation

In the time Jesus Christ was born we had around 0.3 billion people on this world. This didn't change too much the next 1700 years when we reached 0.5 billion people. But already 100 years later in 1800 we reached the level of 1 Billion and 1930 we were already 2 Billion. Now we are 7.5 Billion people. My father was born in the time when there were 2 Billion. On the same place he was standing 90 years ago alone now almost 3 additional people are standing with him on the same place. This is the starting point of every problem: pollution, using every piece of land, climate change or the fights we expects in future about water and territories.

3. Closing

The world and the Titanic... this is not a fair comparison because for this world there is no collision with an iceberg, which subsequently sinks the ship. We already have a few difficulties because biodiversity is already fading and the summers already have record temperatures since recording of the weather began 1881. There will be no real sinking of the world because other forms of life will be created of man and beast, and despite the atom bombs and destroyed rainforest the world will live "somehow". The comparison thus ends, but nevertheless one can still draw comparisons.

On the Titanic, there was a point where no one sensed any danger. The course was already set for collision, but it was not recognizable - no one saw the danger. Then the stage of realizing the danger came. Some experts warned of icebergs - the party went on and the captain did not react. This is analogous to the phase in which the world currently finds itself. The warnings are already so well known that almost every educated man in the world knows all the dangers, even all the captains. Because of the big worldwide party and because we have no suitable organization, however, no captain boldly takes over the helm and takes command. It makes no sense nationally either. The solar collectors and windmills are indeed beautiful but in no way suitable for solving even one of the above-mentioned problems. The next phase on the Titanic is the phase where fear begins as well as clear-sightedness, the end suddenly comes into view as well as the realization that sinking will be inevitable.

This phase will look different for the world because we will have no sudden death. There will only be sad changes that are not perceived as being particularly dramatic because people will only be about 80 years old and will therefore have no comparison to the more beautiful times. Just as we know Lüneburg in Germany today as a heathland and we are satisfied with it we are not missing the previous forests that fell victim to shipbuilding in Hamburg. But the changes will force us to question our lives. Small effects like the flooding of New York, Bangladesh and Venice are just as bad as wars because of water and food. Great disasters are not at all predictable in my opinion, but they will come, such as the breakdown of ocean currents or the extinction of individual species which are indispensable to humans and nature. Then comes the unavoidable collision phase: the impact that affects all of us. Water and food shortages, murder, death, panic and the incomprehension of the past will come. Why did people not change course 200 years ago; or 100 years ago? If one considers the time of National Socialism in Germany nowadays, then the same question arises. Why didn't they act to finish all the murder? And with regard to us the future questions will be: why has it not been possible to react in 2019 on all the negative outcomes of overpopulation?

ROLE OF PROJECT MANAGER'S ETHICAL LEADERSHIP ON PROJECT TEAM'S ABSORPTIVE CAPACITY IN IT PROJECTS

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Abstract: *The main motive of this study was to empirically analyze the role of project manager's ethical leadership on project team's absorptive capacity and to investigate the mediating role of organizational trust and knowledge sharing in this relationship. The results of study show that there is positive impact of project manager's ethical leadership on project team's absorptive capacity. Both the mediators organizational trust and knowledge sharing mediates the relationship. This study analyzed the direct impact of organizational trust and knowledge sharing on project team's absorptive capacity as well. It was found out that organizational does have positive significant relationship on project team's absorptive capacity but knowledge sharing impact is insignificant. This study highlighted that how important ethical leadership is if any organization wants to gain external knowledge. It has also added no of implications to theory and management practices.*

Keywords: ethical leadership, absorptive capacity, organizational trust, knowledge sharing, IT project management.

1. Introduction

Just acquiring the external knowledge in organization is not enough in fact sharing it with the project team members actually brings the positive change. Effective knowledge management in the field of project management is significantly important while acquiring the external knowledge [1]. Similarly role of organizational trust on absorptive capacity is very important because organizational trust not only refers to organization but it includes individual trust as well [2]. If employees of that organization have trust in the organization, then they are more likely to adopt external knowledge in their team. IT industry in Pakistan has shown a tremendous growth over the last few years. According to Pakistan Software Houses Association for IT and ITES (P@SHA) report* published on their website, IT industry contributes 1.4% of the GDP with average IT-growth of 30% per year. This study will analyze the role of project manager's ethical leadership on project team absorptive capacity.

2. Literature Review

a: Ethical Leadership
Ethical leadership is different from other type of leadership like transformational leadership, transactional leadership, spiritual leadership, and authentic leadership. Researchers have found out that ethical leadership relies on different phenomenon both conceptually and empirically, ethical leadership stands on the basis of moral and ethics [3]. Ethical leadership has become the main focus of the organizations due to its impact

on employee's behavior and organization trust [4]. It has become so important because leader creates the ethical environment by his ethical decisions and actions which enables the employee to have trust in organization [5]. Employees in any organization look towards his leader for any decision because leader is the one who has to make decisions so he actually passes through ethics to his team by his ethical leadership [6].

b: Absorptive Capacity
There are many factors which contribute to absorptive capacity in an organization but some key factors are first, how well the organization uses the existing knowledge within the firm. Second, what mode of communication is being used in the organization? Third, the type of technology is being used in the organization [7], [8]. Furthermore [9] claimed in their research that if organizations want to use their existing knowledge, they need to evaluate their performances both good and bad over the past years. And external knowledge is absorbed by an iterative cycle of creating knowledge and learning [10]. Absorptive capacity also helps the organization to solve their problem quickly [11]. According to [12] those organizations which practice the solution of expected problem to be occurred, solve the problem more quickly than those who don't foresee the problem.

c: Organizational Trust
Organizational trust means the degree to which employee willing to have relationship with their organization [13]. It refers to employees trust not only organization but to trust their supervisors as well that is why it is also known as institutional trust. If the employees have trust in organization they are more likely to share not only knowledge but they will share the risk of organizations as well, they will stand with the organization in its bad time [14].

d: Knowledge Sharing
According to [15] knowledge is valueless if it is not used its value can only be increased by sharing it. As discussed above knowledge sharing and knowledge transfer is two distinct processes, furthermore according to [16] knowledge sharing is also two way process knowledge donating and knowledge collecting. Knowledge donating refers to a process in which an employee willingly and proactively transfers his knowledge to another employee. Knowledge collecting means how volunteer is an employee is to gather knowledge or skill from another employee. These both terms are frequently used and endorsed in the empirical studies of leadership [17], [18].

3. Research Framework

According to the literature studied, most of the studies have either social identity or social exchange theory used to explain the impact of ethical leadership on employees (DeConinck, 2015; Manning, 2017). But in this study two theories which are self-determination and social learning theory are integrated to examine the effect of ethical leadership on knowledge sharing, organizational trust and absorptive capacity. Even though the employees are considered as fundamental elements in absorptive capacity (Cohen & Levinthal, 1990) and they play significant role in knowledge sharing (Argote, McEvily, & Reagans, 2003) still existing literature seems in studies about knowledge behaviors of individuals in building absorptive capacity which leaves a gap that needs to be addressed (Rafique, Hameed, & Agha, 2018).

4. Conclusion

According to the literature studied to carry out this research, little research can be found out in which the impact of project manager's ethical leadership on project team's absorptive capacity is seen with the mediating role of organizational trust and knowledge sharing. This study was carried out in software industry and specifically project based software houses. The result of the study shows the positive impact of project manager's ethical leadership on project team's absorptive capacity directly and indirectly with mediation of organizational trust and knowledge sharing too. This shows the positive impact of independent variable on dependent variable. It is pertinent to mention here that the direct of knowledge sharing on project team's absorptive capacity was insignificant, but when the mediating role of knowledge sharing was calculated between the relationship of project manager's ethical leadership and project team's absorptive capacity then this relationship was significant which shows the full mediation of knowledge sharing in this relationship.

5. References

[1]   P. M. Bosch-Sijtsema and L. H. Henriksson, "Managing projects with distributed and embedded knowledge through interactions," *Int. J. Proj. Manag.*, vol. 32, no. 8, pp. 1432–1444, 2014.

[2]   P. H. and H. S. Mika Vanhala1, "Efeito de diferentes tipos de solos na germina????o de sementes de Tabebuia heptaphylla, em casa telada," *Cerne*, vol. 14, no. 1, pp. 62–67, 2016.

[3]   D. M. Mayer, K. Aquino, R. L. Greenbaum, and M. Kuenzi, "Who Displays Ethical Leadership And Why Does It Matter," *Acad. Manag. J.*, vol. 55, no. 1, pp. 151–171, 2012.

[4]   J. Han, J. Zhang, and J. Han, "CFO as a strategic partner of the CEO: Relational demography and firm financial performance," *J. Bus. Manag.*, vol. 21, no. 1, pp. 59–76, 2015.

[5]   C. Frisch and M. Huppenbauer, "New Insights into Ethical Leadership: A Qualitative Investigation of the Experiences of Executive Ethical Leaders," *J. Bus. Ethics*, vol. 123, no. 1, pp. 23–43, 2014.

[6]   R. Steinbauer, R. W. Renn, R. R. Taylor, and P. K. Njoroge, "Ethical Leadership and Followers' Moral Judgment: The Role of Followers' Perceived Accountability and Self-leadership," *J. Bus. Ethics*, vol. 120, no. 3, pp. 381–392, 2014.

[7]   J. Jeon, S. Hong, J. Ohm, and T. Yang, "Causal relationships among technology acquisition, absorptive capacity, and innovation performance: Evidence from the pharmaceutical industry," *PLoS One*, vol. 10, no. 7, pp. 1–14, 2015.

[8]   T. C. Flatten, G. I. Greve, and M. Brettel, "Absorptive capacity and firm performance in SMEs: The mediating influence of strategic alliances," *Eur. Manag. Rev.*, vol. 8, no. 3, pp. 137–152, 2011.

[9]   D. M. Chalmers and E. Balan-Vnuk, "Innovating not-for-profit social ventures:

Exploring the microfoundations of internal and external absorptive capacity routines," *Int. Small Bus. J.*, vol. 31, no. 7, pp. 785–810, 2013.

[10] R. J. Torraco, "Chapter 4 Theory of Knowledge Management," *Knowl. Manag.*, pp. 38–62, 2009.

[11] G. Burt, D. J. Mackay, and A. Perchard, "Managerial hyperopia: A potential unintended consequence of foresight in a top management team?," *Technol. Forecast. Soc. Change*, vol. 101, pp. 134–146, 2015.

[12] S. J. Spear, "Fixing the T : Anticipate problems , then practice responses," no. April 2016, 2017.

[13] M. C. Yu, Q. Mai, S. B. Tsai, and Y. Dai, "An empirical study on the organizational trust, employee-organization relationship and innovative behavior from the integrated perspective of social exchange and organizational sustainability," *Sustain.*, vol. 10, no. 3, 2018.

[14] R. C. Mayer, J. H. Davis, and F. D. Schoorman, "An Integrative Model of Organizational Trust: past, present, and future\n\n," *Acad. Manag. Rev.*, vol. 20, no. 3, pp. 709–734, 2007.

[15] O. Gültekin, "Social Capital's Effect on Physical Education and Teachers' Job Satisfaction," *J. Educ. Learn.*, vol. 8, no. 1, p. 164, 2018.

[16] B. Van Den Hooff and J. A. Ridder, "Knowledge sharing in context: The influence of organizational commitment, communication climate and CMC use on knowledge sharing," *J. Knowl. Manag.*, vol. 8, no. 6, pp. 117–130, 2004.

[17] W. L. Wu and Y. C. Lee, "Empowering group leaders encourages knowledge sharing: integrating the social exchange theory and positive organizational behavior perspective," *J. Knowl. Manag.*, vol. 21, no. 2, pp. 474–491, 2017.

[18] K. K. Jain, M. S. Sandhu, and S. K. Goh, "Organizational climate, trust and knowledge sharing: Insights from Malaysia," *J. Asia Bus. Stud.*, vol. 9, no. 1, pp. 54–77, 2015.

ROLE OF EMPATHY, EMOTIONAL INTELLIGENCE, TRANSFORMATIONAL LEADERSHIP OF THE PROJECT SUCCESS

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Abstract: *People today live in an active movement, striving for significant achievements and rapid development. The emotional intelligence that many speak in recent times is not only the ability to control their feelings, but also the ability to understand other people. How to learn to recognize someone else's experiences? And why empathy is the key to success? The purpose is to track how empathy, emotional intelligence and transformational leadership affect the success of a project. The contribution of this article is a constructed mathematical model of the relationship and the role of the components that affect the success of the project.*
The ability to empathy is a professionally necessary quality for all professionals whose work is related to people (TOP managers, line managers, officials, salespeople, personnel managers, etc.). In a business environment, empathy helps to best build relationships between employees and this not only forms the general culture of communication in a company, but also helps to solve business problems more effectively. Transformational leadership makes subordinate leaders. Employees are given relative freedom so that they can independently control their activities within delineated boundaries. They are involved in the problem-solving process and learn new ways of working, which contributes to increased productivity.

Keywords: emotional intelligence, empathy, transformational leadership, transactional leadership, project success, management of relations.

1. Introduction

The ability to recognize the feelings of another person, and the correct response to her emotions is necessary in very many areas, from trade to social activity.

To create a product or service that you are interested in, you need to know well who will use them. The general characteristics of the target audience: gender, age and profession are undoubtedly important, but for the best companies in the market, this information about the client is clearly not enough. This requires empathy - the ability to empathize with another person, the ability to put himself in his place.

2. Emotional intelligence in project management

Recently, the term emotional intelligence - the emotional intelligence - is becoming increasingly popular, but in science, there is still no clear definition of this concept.
For the first time, the designation EQ - emotional quotient, the emotional factor, by analogy with IQ - the coefficient of intelligence - was introduced in 1985 by clinical physiologist Ruven Bar-On. Together with Daniel Goleman, the most famous in our country, these scientists form the "three leaders" in research on emotional intelligence. The total number of scientists involved in research in this area is enormous.

The concept of emotional intelligence is probably the only theory in management based on neurophysiology. Emotional intelligence is personality traits that give the ability to recognize and analyze the emotions of surrounding people and their own emotions. Thanks to the developed emotional intelligence, project managers are able to achieve their goals using more flexible behavior strategies [1].

With project managers, different situations occur in life, therefore, it is very important to have the ability to interpret your emotions as negative and positive, in order to use your positive thinking to change your state. That's why it often happens in life that people who graduated from school with a gold medal and have diplomas on higher education do not reach professional heights perfectly, because they have not developed enough emotional intellect. IQ does not provide professional success, it is necessary to have a developed emotional intelligence.

Goleman is available to explain how the almond-shaped body, the emotional center of the brain, affects the activity of the cerebral cortex, which is responsible for logical thinking.

Goleman gives the following information in his book that the most effective project managers are those who can show feelings and mind towards subordinates.

Today it is known that without emotional intelligence, effective leadership is impossible. D. Goleman presents convincing data studies at Harvard University: the success of any activity, only 33% is determined by technical skills, knowledge and intellectual abilities (i.e. IQ), and 67 % – emotional competence (EQ). And for heads, these figures differ even more: only 15% of success is determined by IQ, and 85 % – EQ [2].

The project manager in interaction with subordinates should take into account their emotional state. IQ and logic are fully formed before the 17 age, and emotional intelligence develops and improves throughout life [3].

Modern employers are increasingly inclined to employ those professionals who are quick to be guided in life situations, professional problems, are able to be active, take initiative in their own hands, optimistic about the ability to succeed, courageously and well-balanced approach to planning and implementation of work that can prove the case to logical completion, rebuild (to adapt quickly to changes in the design environment), if required by the right. The most successful in their activities are those people who skillfully combine the mind and emotions.

People with high emotional intelligence are:
➢ make decisions faster;
➢ operate more effectively in critical situations;
➢ better manage their subordinates, which, accordingly, promotes their career growth and prosperity of the structure in which they operate.

3. Empathy of project manager

It is clear that the project manager needs to work with interested parties, subordinates, interacting with them, trying to understand their motives, reasons, or their actions. At the same time, "penetrating into the inner world" of colleagues, it is important not to become the victim of manipulation himself.

Simply purely intuitive is attracted to us by an interlocutor who listens carefully to us, understands our emotions and feelings, does not give any marks to our actions, does not torment us with advice "from our own lives", respects our opinion (even if he does not agree with us). Then there is a strange feeling of unity, a feeling that you are both - at one wave.

It is believed that the concept of "empathy" comes from the Greek pathos - a strong and deep feeling, close to compassion, with the prefix em, which means the direction inside. You can feel empathy, even at the root of disagreeing with the point of view of the interlocutor.

Detecting empathy with your interlocutor means to perceive the inner world of another, but without losing contact with oneself. This means that you must retain the ability to return to your world of emotions. If the shade "as if it is with me" (the key part - "like") disappears, then instead of empathy there is an identification with the emotional state of the interlocutor, you become infected with his emotions and experiences to the same extent as he.

Empathy does not mean "putting yourself at the place of the interlocutor," it's not copying his feelings. Empathy is an attempt to look at things through the eyes of the interlocutor. Another very important point: one can feel empathy, even at the root of not agreeing with the point of view of the interlocutor. That is, you are capable of deep understanding of the feelings of the person with whom you speak, you distinguish your own emotions from those that arose in response to the emotions of the "other side" in the conversation.

Many of you probably have heard of a psychologist Carl Rogers, he defines empathy as follows: "Being in a state of empathy means to perceive the inner world of another accurately, with the preservation of emotional and meaningful shades. As if you become this other, but without loss of feeling "like". Yes, you feel the joy or pain of the other, as he feels, and perceive their causes as he perceives them. But there must be a shade of "like": "as if I'm happy or frustrated."

Empathy is not a formal logic nor an appreciable reaction. Empathy promotes effective communication [4].

Project managers in their work constantly feel the need to understand the interlocutor as fully as possible.

This is felt during an interview with a potential candidate for a vacant position, in solving conflict situations, in the formation of a system of motivation, in the creation of project teams, in optimizing the number of staff, in the release of employees - in all these cases, the project manager is vital to listen and hear interlocutors.

For efficient and effective work with the personnel it is necessary to understand the essence of the real motives of the actions of the employee, the source of his interests, the causes of lies, the goals of isolation.

When forming a team (especially in the "storm" stage), various emotions are raging, which is extremely difficult to control and direct in a constructive way. It is worthwhile making a reservation. It is not about the phenomenon of nature, but about the five stages of team formation: formation, storm, normalization, execution and completion.

If we talk about "storms" in a very short way, then you can characterize it so. Initial optimism after a starting jerk gives way to pessimism, if not frightened by the tasks set. A sense of disappointment or disagreement about the goals, responsibilities in the project.

And in order to achieve a general result, it is necessary not only to listen, but also to understand the point of view of each member of the team, to come to a common opinion, while avoiding a clash of interests and the collapse of the team.

If the company introduces a system of motivation based on an individual approach, then only through an empathic hearing (it is also called "active listening") it is possible to determine the internal motives of each employee, and, therefore, get to the point, making a specific motivational proposal to a unique specialist, expert. And, as a consequence of the competent elaboration of the system of motivation, one can solve the problem of retaining the key specialists of the company. And in our time of high competition, the latter task is especially relevant: as a highly professional specialist, an expert can be a talented leader.

Accordingly, when "good" people go, very often take away all their team.

Business erases state and national boundaries. Now no one will surprise anyone with the multinational staff of the company, as it was 15 years ago. Intercultural features of the company require a project manager special knowledge in the field of relations (and business including) and a deep understanding of the intricacies of the culture of different countries and denominations, whose representatives work in the company. In cross-cultural companies, empathy becomes a connecting link in shaping a common corporate culture.

Microsoft CEO Sathya Nadella argues that empathy is a critical component in developing products or concepts that helps understand the needs of people and gain their trust. In addition, the ability to read alien emotions will be needed in negotiations and for conflict situations. The head of this skill will inspire subordinates and lead them with them. The line-up employee is to maintain a friendly atmosphere in the team (and this, as the research shows, has a positive effect on our performance). By showing empathy in working with clients, you can find a common language even with the hardest people.

Usually emotional exchange occurs on a thin, almost imperceptible level. The ability to calm down the painful experiences of other people and the ability to communicate with the interlocutors, who are in absolute fairy tales, are indicators of higher skill. The only effective strategy is this: you need to deeply absorb the feelings of a person, and then adjust it to a more positive wave.

How to develop empathy? It is important to understand that it is closely related to other elements of emotional intelligence - the ability to recognize and control their own feelings. This should be learned first and foremost. The map of empathy was created many years ago by Dave Gray, the founder of XPLANE, the author of the techniques of brainstorming "Geyshtorming", the author of books on visual thinking practices.

Empathy map is an idea rendering tool developed by XPLANE that allows you to put yourself at the user's point of view to take a look at the problem your product solves with your eyes. The map of empathy is a scheme in which the center of a representative of a certain user segment is placed; on the different sides of it there are 4 blocks ("think and feel", "say and do", "see", "hear"). The conclusions are presented in two additional blocks: "problems and pain points" and "values and achievements".

The map of empathy is relevant where you need to look at the product from the eyes of the client:

1. Development of strategy;
2. Launching, completing a product or service;
3. Search for new directions;
4. Improving the level of service;
5. Working with the atmosphere in the company [5].

If the project manager is already familiar with the audience, then the empathy map details the context of the use of the product, at the start of the project will show where the gaps in the data. An empathic map can be constructed for any product, and it does not matter if it is implemented, or exists only in the format of the idea.

So, what you need:

1. Determine the approximate target audience.
2. Conduct a "brainstorming" with a team / customer and fill out a map based on your experience and assumptions.
3. Conduct online research. Not only and not so much how users interact with your product, but how they behave in relation to the problem that your product solves. For example, if your product is a project management system for Microsoft Project, then you need to learn what ways the project management tasks are solved by users, which they like, and what they do not like, which in principle can not be made, and I would like to the tools they involve in the process, etc. But it is important to remember that empathy is different from the impassive study of how a person uses something. Empathy is related to empathy, with the understanding of what the user wants to achieve, no matter if he knows about the product that the team creates.
4. Conduct interviews (potential or real) users. You can also observe their work instead of interviewing (better, in addition to it).

The map of empathy is an instrument of brainstorming. To work in a team was effective, it is important:

- prepare in advance - if they send materials to the participants in 2-3 days, they will have time to get acquainted with the topic, to think about the tasks and to prepare the necessary data;
- speak the main task at the beginning of the discussion - so the project manager will make sure that all participants in one wave know the goals and rules of work.

The information is distributed in blocks as follows (Fig. 1):

1. Think and feel: what is there to doubt? It's better to look for this information where users complain: for example, in forums.

2. Say and do: how does the user behave publicly? What does it say? What is the solution to the problem? This information should be searched on social networks.
3. See: what is the environment in which the user is located? What are the suggestions and alternatives your product faces?
4. Hear: how does the environment in which the user is, affects him? What say colleagues, acquaintances, authoritative sources for him? What media channels have an impact on the user? Unlike the block "see", the information here does not necessarily correspond to reality. But the user trusts her. Where to find information for this block: rumors and thoughts on forums.
5. Problems and pain points: what troubles the user? What is he afraid of? What could be the reason that he would give up your product? Often, the "I Think and Feel" block becomes a source of information for this. All these fears and doubts will have to be dispelled, and this can be done by a bunch of ways: from the "right" text in the interface to the individual consultations.
6. Values and achievements: what will help the user to get rid of problems and doubts? For what product features is he willing to pay? What values should be broadcast? Conclusions from this block affect the product from a variety of different parties: they can cause both small changes in the interface or in the text, and the addition / exclusion of certain functionalities, and sometimes even a change in product positioning [6].

The main risk of the project is becoming "burnt down" employees. The project rhythm and the large flow of tasks cause such people to be annoyed. To understand why such people appear in an organization, consider the model of development of a specialist, built on the parameters "skill / motivation". This model is needed to understand at what stage the "life cycle" can be staffed by the project, and how it affects their motivation [9].
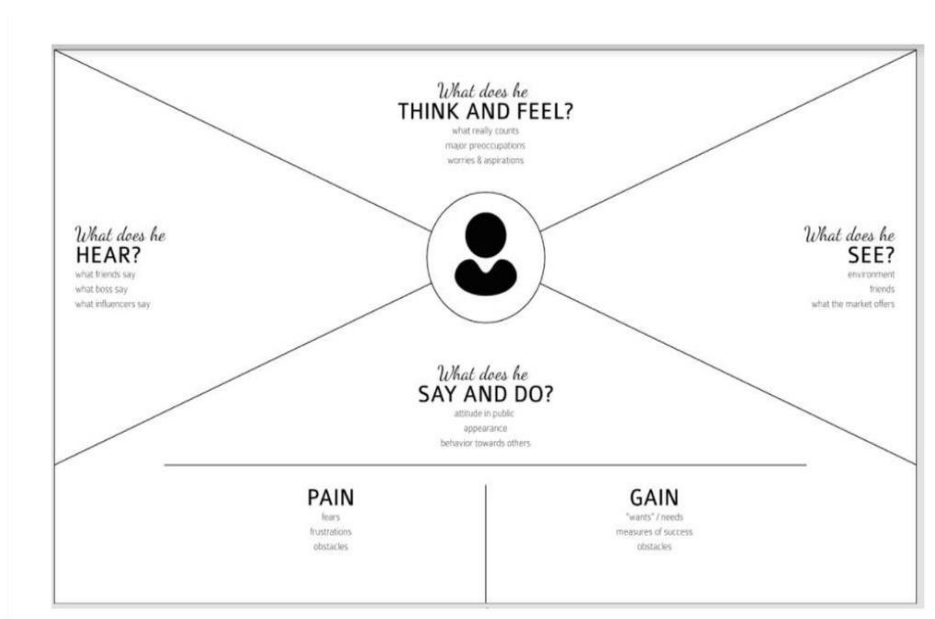

Figure 1. Empathy Card [7]

If we consider the personal change curve of the manager during the life cycle of the project we will get the next model (Fig. 2).
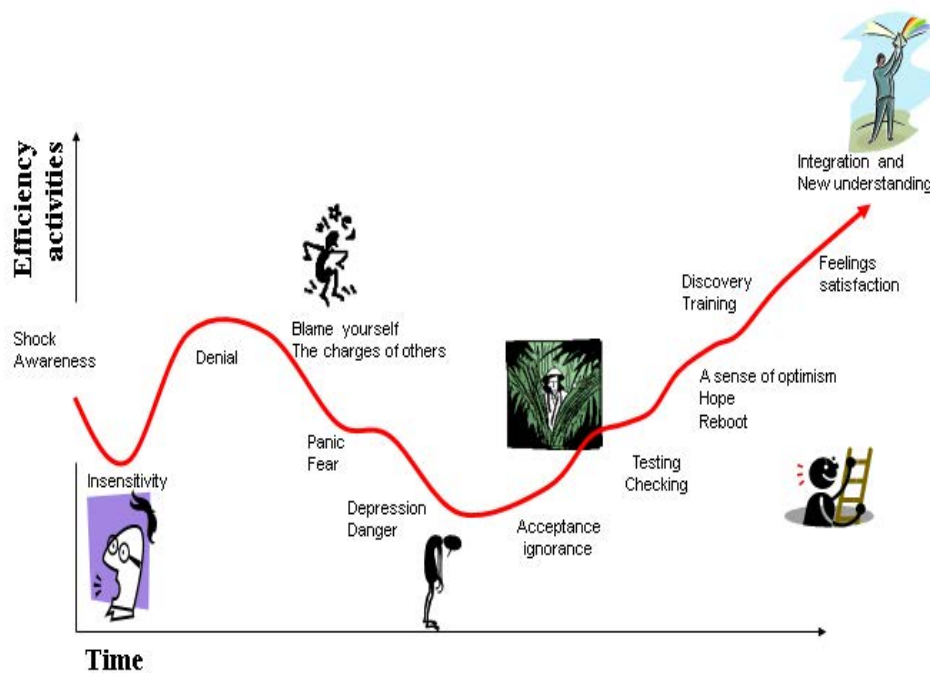
Figure 2. Personal change stages during the life cycle of the project [8]

Earlier in the article "Conceptual model of the project success: emotional intelligence, competences of managers, transformational leadership, values" the research was described and hypotheses were put forward in the form of own mathe formulas, which in this article are expanded and deepened.

Then it becomes apparent that at the beginning of the project there is a decline in the team's activity and the manager needs empathy from the stakeholders and own conceptual model must be presented in two parts in order to achieve a balance:

$$Motivation = Emotional\ Intelligence + Empathy \qquad (1)$$

$$Project\ success = Emotional\ intelligence + Transformational\ leadership + \\ Competencies\ of\ project\ manager + Values \qquad (2)$$

The motivation of the team at the beginning of the project is most affected by the emotional intelligence of employees and the empathy of the stakeholders.

Stage 1 - little experience, lots of enthusiasm (low skill, high motivation). This may be a young specialist who got his first job; a person who has decided to try himself in a new profession or a professional who has been promoted to a managerial position. In general, any of the options when a person just came to a new place is very keen to succeed, but still does not understand how to do it.

Stage 2 is the first disappointment (low skill, low motivation). At this stage, our expert comes to the understanding that everything is not as easy as it seemed at first. He makes the first mistakes, succeeds at once, and, most importantly, comes the understanding that the path to the summit is long enough and not at all as simple as it seemed at first.

Stage 3 - natural growth (skills are increasing; motivation is different). If a specialist manages to overcome the previous stage, he enters the path of professional growth. It is already clear what exactly needs to be done for development, it is also clear that the path to success lies through a long methodological work. This stage is usually quite long, with its black and white stripes, so

there is not one level of motivation on it, the only thing that can be said is usually enough to keep moving forward.

Stage 4 - Competent specialist (high skill, strong motivation). At this stage, the specialist goes to the competence plateau, and can begin to perform tasks autonomously (without a manager), gradually expanding his sphere of responsibility and helping beginners at work. Ideally, having worked for some time in this mode and having prepared a replacement, the employee goes to the raise and returns to the first stage, starting a new turn of his career spiral.

In real life, unfortunately, it often happens not so. New posts are not always available, and teaching yourself a worthy replacement does not allow for the absence of any candidates for this post, so the next stage comes.

Stage 5 is a very competent specialist. This condition is described by the English word "overqualified" and indicates a significant discrepancy in the competence of the specialist and the needs of his office. The state is characterized by a constant decrease in motivation, due to the lack of a positive connection from the implementation of complex, interesting tasks. After some time, the decline in motivation leads to disappointment from work, and shifting the priority from work to something else (hobbies, families, and outsourced projects). Typical external attributes: a person starts to work strictly on schedule, and at a meeting more speaks not about his work, but about something that took her place in the system of priorities. Man at this stage does not necessarily work badly. On typical tasks, lack of motivation from a good specialist is offset by a high level of professionalism. Problems begin if complex tasks appear that require exit from the comfort zone; in this case there will be behavior that is the opposite of the expected - instead of labor enthusiasm there is a rejection or even resistance. This is because solving problems beyond the competence requires a high place in the system of priorities, and the place is already occupied by something else [10].

Expectations of management begin to disagree with the behavior of the employee.

The final, sixth stage of this process will be professional degradation, and the person from the state "may, but does not want" goes into the state "does not want and can not." Such employees are either cut short by the state's next optimization, or they end their path in "paper" positions with a low level of responsibility.

4. Common features of transformational leadership and emotional intelligence

Recently, the classification of leadership has changed, in particular, Burns includes the following formats:

- ✓ Transformation;
- ✓ Transactional;
- ✓ Non-intervention.

Transformational Leadership. Leaders put the needs of employees higher than their personal.

Transaction leadership has three components:
- ✓ Contingent remuneration, while the productivity of subordinates is related to conditional rewards;
- ✓ Active management, through which leaders monitor effectiveness and apply corrective actions if deviations occur;
- ✓ Passive management (leaders intervene only when problems become serious)

The third type of non-intervention leadership. This leadership style can be described as non-leadership or avoiding leadership responsibility. Leaders do not respond to requests for help, and oppose the expression of their views on important issues.

Leadership is undergoing fundamental transformation today, the transformation from a leader critic to a leader as a partner and coach takes place. This role transformation requires some skills, because leadership is what you do with people, not with them. Numerous studies have shown that transformational leadership positively affects productivity, job satisfaction. Therefore, we can assume that the skills

The transformational leadership will stimulate efficiency and innovation in this volatile market:

- ✓ Idealized influence;
- ✓ Inspirational motivation, where the leader inspires and supports team spirit;
- ✓ Intelligent stimulation, when a leader encourages creativity and innovation;
- ✓ Individual consideration when a leader maintains and supervises every follower [11].

Transformational leaders use intellectual stimulation to encourage innovative ways of working and problem solving.

Transformational leaders stimulate and inspire followers to achieve extraordinary results, as well as develop their own leadership potential. Transformational leaders take into account the needs of individual followers.

Salovey argued in their first article that there is another type of intelligence called emotional, which can help to better understand who has succeeded than the ratio of mental abilities [12].

Guided wisely, leaders get incredible value from emotions and the development of real self-efficacy. Emotional intelligence helps leaders make better decisions and receive effective returns from their employees. Scientists have found that cognitive abilities predict less than 2% in efficiency, while 25% of the variation in productivity is explained by emotional intelligence.

The transformational leader demonstrates empathy, motivation, self-consciousness and self-confidence. Goleman described the above subcomponents of emotional intelligence. Emotionally, intellectual leaders use empathy to connect to the emotions of other people they lead. These leaders sympathize with and also express emotions that are group experiences. Thus, the team feels that the leader understands it.

Goleman said that 80-90% of success is determined by the presence of emotional competencies [13].

Charisma, a trait of transformation leader, is well-developed social and emotional skills. Emotional intelligence is both a basic and a necessary component of personal charisma demonstrated by transformational leaders. Transformational leaders use emotions to communicate and motivate followers.

Sosik proposed four points in which the emotional intelligence and transformational leadership intersect:
- ✓ Compliance with professional standards of conduct and interaction that are associated with idealized influence or charisma;
- ✓ Self-motivated, as ability to control;
- ✓ Intelligent stimulation: a leader must be able to stimulate professional and intellectual development. Bass has established trust as the main component of the transformational style of leadership. And Cooper offered trust as an important characteristic of emotional intelligence;
- ✓ Individual focus on others [14].

The level of emotional intelligence leaders regulates their ability to control the feelings and emotions of teams and motivate them to achieve their goals. Such leaders inspire their teams through positive thoughts and a clear vision.

Each manager has the ability to develop the emotional competence of the team and become a resonant leader. Leaders with high emotional intelligence are self-conscious and they understand themselves, they are sympathetic and attentive. This resonance comes naturally to emotionally intelligent leaders, and this resonance boosts productivity. Caruso argued that the exact recognition of emotions in others is critical to the ability of leaders to inspire and build relationships. Empathy precedes the transformational behavior of leadership. Such leaders also develop team spirit, role modeling enthusiasm, high moral standards, integrity, optimism and meaningful work for followers.

Rather, he studied the relationship between leadership style, intuition and emotional intelligence for women and men leaders. He found that female managers show transformational leadership behaviors more often than men and have higher levels of emotional intelligence and intuition. Intuition correlated significantly with the emotional recognition and expression, and the emotions of direct cognition.

5. Possibilities of developing empathy and application of results in the project

As mentioned above, we understand others by realizing their own emotions. If you have already mixed up with your feelings, you can go to the training of empathy. To do this, use the following tools.

Many of us listen indifferently, trying to do something else at the same time or plunge into their own thoughts. An amputation hearing occurs when we completely devote ourselves to another person. Here's how you can develop this skill:

1. Allow others to speak. You do not need to provide verbal or non-verbal tips and to arrange for a person a proposal. When we interfere, we inadvertently direct the interlocutor to what we want to hear, instead of letting him talk in the right direction.

2. Give the speaker an absolute attention. Perhaps you know how it is when a person is doing other things while he is listening to you. Whether he is reading something on a computer or looking over your shoulder, wanting to see someone, this seems like a disgrace.

3. Play and generalize. Periodically repeat what you have heard to make sure your understanding is accurate. It offers the speaker an opportunity to reformulate or explain some thoughts. For example, you can say: "Yes, right, did I understand the situation? Do you feel disregard for the boss when he does not say positive about your contribution to the common result?"

4. Focus on emotions. Hearing with empathy involves interpreting the thoughts and feelings of others. In addition to playing and heard generalization we can also add sympathetic words to what they say, such as "Sounds depressing" or "You look angry."

5. Put yourself in someone's place. Do not interfere with the interlocutor from the position of advantage: "Guy, that's what you have plucked". Instead, think like this: "How is it, to be in place of this person right now? What would I feel in this situation? "

6. Reject judgments. The hearing about empathy involves refusing our own judgments, needs, and priorities and concentrating on another person [15].

What we do with the information received during the hearing is also important. Often, there is a temptation to recall its own story and suggest a solution to the problem. This method is not very empathic. A more effective approach is simply to say: "It seems difficult," "How can I help?" Or "What support do you need right now?"

6. Results and Conclusion

The considerations explained in this contribution EQ is a necessary factor in enhancing mental skill, because the recognition of their feelings and manage them in a constructive way increases the intellectual power of the individual. To increase the level of emotional intelligence may be possible, but not through traditional training programs aimed at the part of the brain which controls our rational ideas, and long practice, feedback from colleagues, and personal enthusiasm in the desire to change yourself is an essential step to improving EQ, and as a result, successful self-realization.

Actively using empathy in the exchange of information, we are trying to appropriately adjust the receiving side and adapt the option of coding and transmitting the message to the individual or group and the situation.

A successful application of empathy can significantly reduce the possibility of misunderstanding when decoding a message by the receiving person.

How to learn empathy? Start with yourself. Live in harmony with yourself, be positive and transfer your mental comfort and positive feelings and attitudes toward life in relationships with friends and colleagues around you, look for individual ways of interaction that will help to unleash the potential (both yours and your interlocutor), to find resources for fruitful cooperation.

Sometimes people tend to confuse pity and empathy. And if pity can damage business, then empathy is not. Empathy does not imply indifference. On the contrary, it is an understanding of the complicated, tragic (or, conversely, happy) situation of the employee and the ability - if necessary - to help him.

Transformational leadership enhances the motivation, morale and productivity of followers through various mechanisms. In this model, the leader is a role model for his followers.
As a result, this article describes how emotional intelligence, empathy, and transformational leadership influence the success of a project.

7. References

[1] N. Rusan, S. Bushuyev, D. Bushuyev, "Emotional intelligence — the driver of development of breakthrough competences of the project", IEEE, 5-8 Sept. 2017 International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT), Lviv, Ukraine. – P. 1-7.

[2] D. Goleman, "Emotional intelligence in business" - Mann, Ivanov and Ferber, Moscow; 2013.

[3] N. Rusan, S. Bushuyev, D. Bushuyev, "The relationship of emotional intelligence, creative potential and efficiency of the project manager", The International Research Conference at the Dortmund University of Applied Sciences and Arts took place on June 30 – July 1 2017 for the seventh time.

[4] N. Sargwelladze, "On the Balance of Projection and Introection in the Process of Empathic Interaction" // Unconscious: Nature, Functions, Methods of Investigation: 4 t. / By common. edit A. S. Prangishvili, A. E. Sharoziya, F. V. Bassin. T.3 Tbilisi, 2009.

[5] Bland, D. "Agile coaching tip – What is an empathy map?" 21 April 2016. Retrieved from https://www.solutionsiq.com/resource/blog-post/what-is-an-empathy-map/

[6] Gray, D., Brown, S. & Macanufo, J. 2010. "Gamestorming – A playbook for innovators, rulebreakers and changemakers". Sebastopol, CA: O'Reilly Media, Inc.

[7] Gray, D. "Updated Empathy Map Canvas." Medium. 15 July 2017. https://medium.com/the-xplane-collection/updated-empathy-map-canvas-46df22df3c8a

[8] John Fisher, Process of Personal Transition, 2012. https://www.businessballs.com/change-management/personal-change-stages-john-fisher/

[9] Carl Belack, Daniele Di Filippo, Ivano Di Filippo, "Cognitive Readiness in Project Teams: Reducing Project Complexity and Increasing Success in Project Management". Productivity Press; 1 edition (February 18, 2019).

[10] J. Decety, W. Ickes, "The Social Neuroscience of Empathy (Social Neuroscience)". MIT Press, 2011.

[11] Daniel Goleman, Richard Boyatzis, Annie McKee, "Primal Leadership, With a New Preface by the Authors: Unleashing the Power of Emotional Intelligence". Harvard Business Review Press (July 23, 2013).

[12] P. Salovey, M. Brackett, S. Rivers, "Emotional intelligence: Implications for personal, social, academic, and workplace success" / M. A. Brackett, S. E. Rivers, & P. Salovey // Social and Personality Psychology Compass, 5(1). – 2011.

[13] D. Goleman, "Emotional intelligence at work" / Daniel Goleman; lane. From English. A. P. Isaeva. – M.: AST MOSCOW; Vladimir: VKT, 2010.

[14] J. Sosik, "Full Range Leadership Development". Routledge; 1 edition, 2009. – 424 pages.

[15] Karla McLaren, "The Art of Empathy: A Complete Guide to Life's Most Essential Skill". Sounds True; 10/16/13 edition (October 1, 2013).

SUCCESSFUL GOVERNANCE OF PROJECTS FROM THE PERSPECTIVE OF VIRTUAL TEAMS

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Abstract: *Virtual teams (VTs) are getting more and more attention as they become important agents in bringing projects to completion. Virtual teams are considered teams whose members are geographically dispersed and cooperate via communication technologies. While the benefits of working virtually may be numerous both for organizations and team members, the challenges that occur in the process may hinder the effectiveness and performance of virtual teams and affect the projects they conduct. Organizations may be in the position to influence how these teams work and one modality would be by means of governance; and in case of projects, through governance of projects. Several frameworks have been developed for governance of projects; however, these have not specifically considered virtual teams. The present research investigated the influence governance of projects may have on virtual teams and a framework for governance of projects that enable virtual team effectiveness and performance has been developed.*

Keywords: virtual teams, challenges, effectiveness, performance, governance of projects

1. Introduction

With the development and accessibility of technology, working virtually became a desired way of running projects for many organizations in the current dynamic business settings. By leveraging local resources, companies are able to access knowledge that would not be available otherwise and to reach markets where on-site expertise is crucial. Furthermore, as [1] noticed, organizations are able to reduce travel costs and rapidly respond to market demands, having the advantage of working around the clock, due to team members working from different time zones. On the other hand, team members benefit from increased flexibility [2].

Nonetheless, virtual teamwork can also carry challenges. Lack of face-to-face communication and difficulties with the use of communication technologies generate the most challenges, but cultural differences are also important causes for miscommunication.

[3] highlights the importance of an existing setting or framework, where VT members are supported to function properly. [1] noticed that in organizations, support systems offered by top management (e.g. human resource (HR) instruments, resource allocation, coordination) contribute to a better project coordination and monitoring. Additionally, according to [4], governance affects projects, as it impacts how people behave. This can be considered true both in case of traditional project settings and in case of projects conducted in virtual environments. Therefore, it is important to consider organizational support and governance structures in companies for enabling the performance and effectiveness of virtual project teams.

1.1. Research question and methodology

Many facets of VTs are covered in the existing literature (e.g. the need for autonomy, trust, role clarity, virtual team processes) and likewise, topics related to how governance of projects impacts project success are numerous. However, the identified and reviewed frameworks of governance of projects [5],[4],[6],[7] are not specifically considering VTs. Understanding the role of governance of projects in enabling virtual project teams may contribute to the research in the field of VTs. Therefore, the present research proposed to investigate the following research question: *To what extent can governance of projects have impact on the effectiveness and performance of virtual project teams?*

Answering the research question may shed light on the elements of governance of projects that contribute to a more effective and performant virtual cooperation, a field with many challenges, as the following sections will display.

In order to better understand the field researched and to answer the research question, a narrative literature review has been conducted. The aim of the literature review was two-folded: to acquire understanding and ground the knowledge base for the investigation and identify the ways how governance of projects may contribute to the work of virtual project teams, and as a result, to answer the research question.

The literature review included four steps. However, it has not followed a linear process, in the way that some examinations were conducted simultaneously or the search was reconsidered due to new information identified. The four steps are as follows:

1. The first literature search focused on keywords such as "governance of projects", "project governance", "virtual teams", "distributed teams", "virtual project teams", "distributed project teams". This step resulted in differentiating the terms "project governance" and "governance of projects" and understanding the interchanging use of the adjectives as "virtual", "distributed" and "remote". Furthermore, it provided the needed documentation for defining and describing the diversity of virtual teams.

2. The second literature search aimed at identifying studies related to virtual team effectiveness and performance and the keywords used were: "virtual/remote/distributed team effectiveness" and "virtual/remote/distributed team performance". This step was relevant for inventorying the measures and tools that are important for enabling VTs and which can be incorporated in the framework that the paper proposes.

3. The third part focused on aspects and terminologies that needed clarification (such as terms directly related to projects or project management).

4. The fourth part focused on the identification of already existing governance frameworks for VTs, as the paper proposed to provide its own framework.

The selection of literature was made according to its relevance to the topic, and mostly focused on books and peer reviewed research articles.

2. Virtual teams

According to [2], virtual teams cannot be included in established team typologies. Moreover, they not only differ from traditional teams, but also from one another. Two main characteristics distinguish them from co-located teams: (1) spatial distance among team members and (2) team members interacting through communication technologies [2]. Furthermore, the same authors [2] also differentiate VTs based on four characteristics. (1) *Temporal distribution* may affect the ability of team members to cooperate across time. Additionally, time can be perceived differently depending on the type of technology used. While synchronous communication technologies allow real time cooperation, asynchronous communication technologies (e.g. e-mails) add to the temporal distribution in VTs. (2) *Boundary spanning* refers to virtual teams crossing several boundaries – functional, organizational or cultural. For instance, involving external consultants or having team members with different cultural backgrounds. (3) The *Lifecycle* of VTs may also differ depending on their tasks and competences needed in the project. Thus, the membership of virtual teams can be dynamic, members leaving and joining teams according to the need of their expertise in the projects. (4) *Member roles* also influence VTs, as sometimes team members need to take on different roles and perform varying tasks. Additionally, the role of task complexity is crucial in determining the characteristics of VTs, which also moderates team composition and structure [2]. Thus, with high task complexity the need for synchronous communication increases, membership stability and shared procedures are critical, and performing multiple roles becomes difficult [2].

[8] highlight the importance of team leaders and members knowing their type of virtual teams, as each type involve different challenges and require different sets of methodologies, tools and resources. The authors distinguish seven virtual team types: networked teams; parallel teams; project and product development teams; work, functional or production teams; service teams; management teams; and action teams. The main focus of the present paper was, however, on *Project and product development teams*. These are described as teams that cooperate to deliver a specific result, have a certain amount of decision-making authority, teams may have shifting membership, but clear boundaries, and tasks are nonroutine [8].

As *virtual teams* in the present research are examined from the perspective of projects, these are defined as: teams, whose members are geographically dispersed and are cooperating through communication technologies with the scope to deliver a specific project.

2.1. Virtual team challenges

Several challenges have been identified in the existing literature. The lack of face-to-face communication affects performance management, as it reduces the capacity of leaders to monitor the team activity and to develop team members [2]. On the other hand, team members have difficulties comprehending the overall team environment. Additionally, crossing cultural boundaries brings communication challenges due to differences in language, traditions or values [2]. [9] also mentions social challenges, as team members may feel isolated and demotivated, and establishing team spirit becomes more difficult, as well as building trust. The author also considers that setting up technologies and learning processes may bring challenges. [10] emphasize the risk of communication breakdown related to cultural differences, interpersonal relations, leadership, technology and trust. It is important to mention, that the authors [10] include in cultural differences, the functional (capabilities and differences in knowledge base), organizational (company culture-behaviors learned) and national differences. Interpersonal relationships may be affected my miscommunications, confusion and anxiety; leadership by the risk of undefined goals and unclear expectations - leading to ineffectiveness. Technology related difficulties appear when no processes are defined. Lastly, the inability of building trust is one of the major causes for virtual team failure [10].

2.2. Virtual team effectiveness and performance and the implications for organizations

As terminologies in current literature are not always clearly defined, the present paper considers the following delimitations: (1) *virtual team effectiveness* is the capacity of VTs and their members to achieve project goals within given constraints; (2) *virtual team performance* is considered the ability of team members to apply knowledge and skills to reach the project goal. In this regard, in order to achieve virtual team success, [11] highlights the importance of quality decision-making and autonomy and reducing formalization, as it is not beneficial for virtual teamwork. [9] found that high-performing VTs have 8 characteristics: global mindset of team members, shared responsibility, culture of tolerance, meaningful communication (clear rules of communication), easy access to information, conflict management mechanisms, work systems that are effective, and positive attitude. According to [12] the factors that are critical for successful virtual project execution are trust, clear communication, technical and organizational support. The latter may take the form of tools, policies and infrastructure offered to VTs, but also in form of rewards and incentives. [13] mention as important for VTs - role clarity, communication media being aligned with the message intended and investing time in increasing understanding among members. [14] suggests that structured collaboration tools are enhancing hard skills, but unstructured collaboration tools are needed to increase collaboration among virtual team members. According to the authors, in order to fully take advantage of VTs, besides providing tools, processes and procedures, the support and coordination from top management is needed.

As organizations are the owner of the resources, their decisions and actions can influence how VTs perform, and can indirectly support also the work of project managers. [8] enumerated 7 organizational factors that can influence virtual teamwork: human resource policies, training and on-the-job education and development, standard organization and team processes, use of electronic collaboration and communication technology, organizational culture, leadership support of VTs, and team leader and team member competencies. [15] found that organizational support that contributed to virtual team effectiveness are: strategic staffing, training and tools, team autonomy, and top management monitoring.

In conclusion, project managers, as leaders of virtual teams, may have influence on VT effectiveness and performance, however organizations through providing the necessary resources can support the actions of project managers and the overall VT environment.

3. Governance of projects

According to [4], governance coordinates methods and processes with the scope to define the organization's goals, allocate resources in order to achieve the objectives and controlling the progress. Moreover, governance descends to lower organizational levels, all the way to project level. As terminologies in literature with regard to project related governance are not clearly defined, under the term "*governance of projects*" the paper understands the overall governance – as an umbrella – of all projects of the organization. Governance is considered more and more as a holistic approach [7],[16], where governance functions are seen in interdependence and having influence on each other. Moreover, it shifted from shareholder orientation to stakeholder orientation, where the shareholder is only one of the stakeholders. Additionally,

as [4] and [6] recognized, it is important to align projects and portfolios with the organization's corporate strategy.

From the existing frameworks analyzed, while [5] focused more on functions closer to corporate governance, [4],[6],[7] recognized the importance of portfolio management and the role of Project Management Offices (PMOs). Elements, that the frameworks examined consider as important can be included in the following main function types of governance of projects: strategic alignment, integrity management, system management, audit management, risk management, stakeholder management, project sponsorship, portfolio management and performance evaluation.

As of the development of governance frameworks, [17] highlights, that governance - in order to be effective – needs less structure. Moreover, inflexible and formal structures impede initiatives and trust, and the development of a governance framework should take into consideration the context it is implemented in [17].

4. Discussion

As the literature review reflected, virtual teams may take many forms and may carry several challenges. Nonetheless, the two basic characteristics of VTs are that team member are dispersed geographically and use communication technologies for cooperation. Based on the literature review, it can be concluded that the challenges that virtual teamwork imply can be divided in two main groups: communication challenges and leadership challenges. *Communication challenges* – due to lack of face-to-face communication, difficulties with setting up technologies, cultural differences - may lead to ineffective relationships, confusion and anxiety, social challenges, isolation or misunderstandings, and hinder productivity and innovation. *Leadership challenges* emerge partially as a result of communication issues and partially due to the particularities of the virtual setting. These imply the reduced capacity of monitoring teams, coaching team members, or difficulties with establishing team spirit. These two types of challenges, however, cannot be delimited entirely and can be related to a certain point.

As the virtual environment brings such challenges and adds to the complexity of project teamwork, it is important that governance frameworks take into consideration virtual teams and incorporate the support mechanism that enable their performance and effectiveness. [15] highlight that organizational support, in order to contribute to teamwork effectiveness, needs to be perceived positively by team members, and employees in general.

As already mentioned, increased formalization is not contributing to team effectiveness [11],[10],[17]. Yet, the existence of standards and processes - especially those related to communication - that support virtual work and role clarity, contribute to the performance of virtual teams [8],[3].

Human resource (HR) policies appear to increase both team performance and effectiveness, as through them team members are easier to be motivated and can also contribute to strategic staffing, which is vital for quality decision making - a major contributor to VT effectiveness.

Performant standardized communication technologies are indispensable for the effectiveness of VTs, therefore organizations need to be ready to invest in it, but also to provide trainings and technical support, so that team members use these technologies with confidence. On the other hand, unstructured communication tools, that are used by team members in everyday life, are also desirable, as these may reduce formalities among team members [14].

Top management support also needs to be mentioned as a VT effectiveness and performance enhancer – also indicated by [14] and [15] – as, through coordination and recognition, influences decision-making quality and the overall team atmosphere.

4.1. The relevance of governance of projects for virtual teams

Authors of frameworks for governance of projects cited in the present paper had different perspectives and audiences, therefore the focus here is to direct the attention to those elements that may be relevant for virtual teams.

VTs need to be treated distinctively by the organization, therefore stakeholder orientation is important for entities that work with such teams. Strategic alignment and risk management need to be considered, but indirectly. In case of strategic alignment, the more direct link should be with portfolio management, where the prioritizing and monitoring of projects is conducted, having in focus the organization's overall goals.

As [1] recognized, VTs, compared to co-located teams, are more invisible for corporate management, therefore the particularities of virtual teamwork are often overlooked. In this regard, it is important that risk management considers also the risks related to virtual work.

As mentioned earlier, top management support is important for VTs. Thus, project sponsorship also needs to be part of a governance framework that considers virtual teams.

Resource management in general, and HR management in particular, were not directly included in any of the governance frameworks analyzed. However, the latter are critical for virtual teams, being mentioned also in the cited literature [8],[18],[14],[15]. Besides strategic staffing and assessing the skills and overall contentment of team members, human resource management should focus on increasing the capabilities of project managers that are related to leading VTs.

PMOs may also empower virtual teams by allowing the information flow and by monitoring the overall virtual project environment, and in the same time assessing the performance and effectiveness of VTs. This way PMOs may offer the needed support by providing the necessary schemes that help clarifying roles and the share of information among dispersed team members. This is also backed by [19], who recommends that PMOs offer project managers in virtual environments additional administrative and leadership support.

Lastly, communication technology management should be considered for the governance framework, as the top VT enabler and it should provide the required technologies, but also the processes and trainings on how to use the given technologies. As [20] recognized, team members adapt much faster to the virtual setting if they receive training both on technology and processes that guide them how to use these instruments.

4.2. Governance of projects framework for virtual teams

Based on the literature review and the above analysis the following framework for governance of projects, that acknowledge virtual teams, has been developed.

The proposed framework, as shown in *Figure 1*, is seen as an integrated part of the corporate governance and it includes only those elements that are important from the perspective of virtual teams. Its functions are arranged in 3 groups: *Objectives, Resources* and *Control*. Furthermore, it reflects the influences both at project start and during project execution.

The *Objectives* group aims to assure (through *Strategic alignment*) that projects are contributing to the organization's objectives, by the means of proper selection and control of projects and programs (*Portfolio management*) and through strategic reporting and performance monitoring (*PMO and performance evaluations*).

Through the *Resource* group are allocated the necessary resources for project execution and for empowering VTs. As part of this group, *System management* is providing the policies and processes that are needed for effective and performant virtual project work. These should be correlated with the other processes of the organization, but need to make sure that the particularities of virtual teams are considered. According to [18], if existing structures are not encouraging virtual work, these need to be adapted. *Project sponsorship*, also part of the *Resource* group refers to the "political support" and to the capacity of top management to influence resource allocation. It can also increase the leadership support of project managers and above all, it can offer the public recognition of VTs, which is important as their visibility is usually reduced within the company. *Resource management*, as the last part of the *Resource* group, is responsible for providing the basic resources for fulfilling the given tasks. However, the framework proposed additionally incorporates three subcategories: Information Technology and Communication (ITC) Management, Communication management and HR management. *ITC Management* is in charge of providing the technological infrastructure for virtual communication and knowledge sharing, but it also needs to supply the processes for using the given tools. The importance of processes for how to use technology is also mentioned by [9], [10] and [3]. Moreover, it is essential that ITC Management supports VT members as they execute projects and do any technical on-boarding for newcomers or in case new technology or process is brought in.

The role of *Communication management* is to provide the standards in communication in order to reduce the chance of miscommunications and to increase the cooperation among VT members. As a major part of challenges occur as a consequence of ineffective or inadequate communication, the role of *Communication management* is critical for effective virtual project conduct.

HR management can influence virtual teams in many dimensions. By strategic staffing, it can assure that teams include members that are the best contributors to the project or for the given stage of the project. Through trainings, it can help teams become more effective and performant. This entails both providing the skills needed for handling the virtual setting (for team members, but also for the leaders of VTs), and reducing the existing or perceived cultural or organizational distances. Moreover, it can introduce methods or techniques for conflict management, eliminating social challenges and put in place reward systems that recognize the efforts of VT members and increases motivation. In conclusion, *HR management* can

contribute to a better task achievement, but it can also deal with social, behavioral, cultural and managerial dimensions of virtuality.
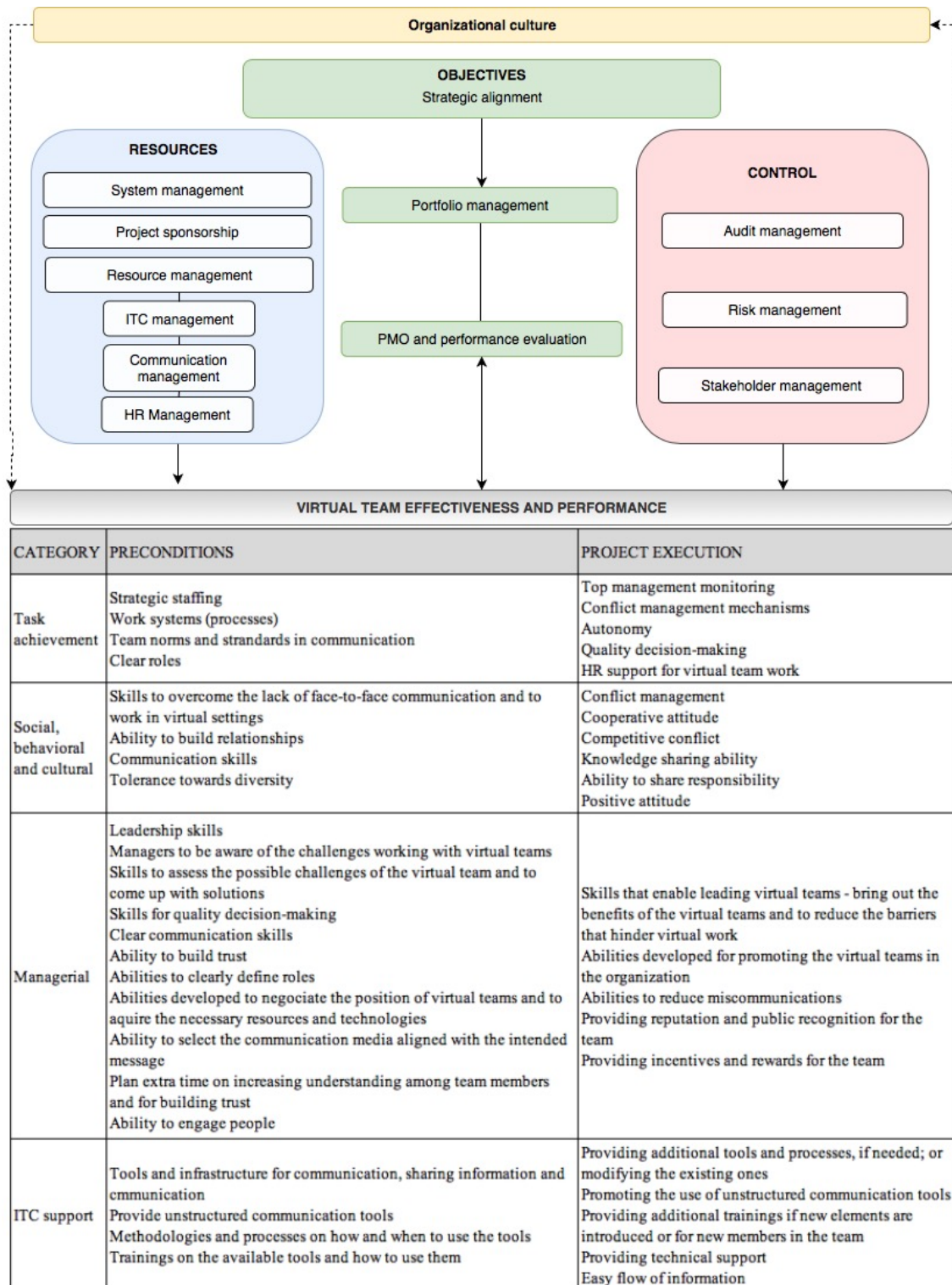
1. Figure - Governance of projects framework for virtual teams (own)

The *Control* group also consists of three functions. *Audit management* is monitoring and controlling the way resources for supporting VTs are allocated and used. *Risk management*, is responsible for assessing the risks related to the overall project portfolio of the company, but it should also consider the particularities

of virtual settings that bring extra challenges and complexity to the project environment, which increase the risks for the company. Therefore, these risks should be treated at governance level. *Stakeholder management*, considered directly or indirectly in their governance frameworks by [5], [6] and [4], is meant to consider the needs and "well-being" of VTs, as their members are dispersed and it is more difficult to understand and fulfill their expectations.

The *Organizational culture*, not directly included in the framework, may contribute to the welfare of VTs by raising awareness inside the organization with regard to VTs and by promoting a global mindset and acceptance of cultural diversity. According to [9], these are important for the performance of virtual teams.

5. Conclusion

Virtual project teams are an asset for the organization, in case challenges are considered and managed. There are several aspects of virtual project work that may be considered for increasing the performance and effectiveness of virtual team. However, the present paper considered the topic from the perspective of governance of projects.

As a result of a thorough literature review and analysis, the research question has been answered positively, governance of projects can contribute to the effectiveness and performance of virtual team and the outcome of the analysis took the form of a framework of governance of projects that takes into consideration virtual teams. In order to increase virtual team effectiveness and performance, four aspects of virtual teams may be impacted (as shown in Figure 1): task achievement; social, cultural and behavioral aspects; managerial aspects; and ITC support.

The present paper contributes to the research field of virtual teams, as it proposes a framework of governance of projects that has not yet been considered before and it can contribute to a better project conduct in the virtual environment. The framework can be also a "tool" for professionals, as it provides practical details on how to increase the effectiveness and performance of virtual teams through governance of projects.

It is important to mention, however, that the framework may be relevant mostly in virtual teams, where all members are part of the same organization. On the other hand, project leaders of virtual teams, if trained for the virtual setting, may positively influence also the cooperation with members outside the company.

The research, during the analysis, found some topics that may be further investigated, as these may deepen the understanding on how virtual teams can become more effective and performant. Therefore, the paper provides new research topics, as well. The field that need further research is resource management and the different ways it can influence the work of virtual teams. Furthermore, the type of processes and their role in increasing virtual team effectiveness and performance may also bring new perspectives on virtual teams.

5. References

[1]   N. Drouin, M. Bourgault, and C. Gervais, "Effects of organizational support on components of virtual project teams," *International Journal of Managing Projects in Business,* vol. 3, no. 4, pp. 625-641, 2010.

[2]   B. S. Bell and S. W. Kozlowski, "A typology of virtual teams: Implications for effective leadership," *Group & Organization Management,* vol. 27, no. 1, pp. 14-49, 2002.

[3]   R. Friedrich, *Virtual Team Maturity Model*. Springer, 2017.

[4]   R. Müller, "Project governance," ed: Gower, 2009.

[5]   P. S. Renz, *Project governance: implementing corporate governance and business ethics in nonprofit organizations*. Springer Science & Business Media, 2007.

[6]   P. Dinsmore and L. Rocha, "Enterprise project governance," *New York: AMACOM,* 2012.

[7]   E. G. Too and P. Weaver, "The management of project management: A conceptual framework for project governance," *International Journal of Project Management,* vol. 32, no. 8, pp. 1382-1394, 2014.

[8]   D. L. Duarte and N. T. Snyder, *Mastering virtual teams: Strategies, tools, and techniques that succeed*. John Wiley & Sons, 2006.

[9]   Y. Zofi, *A manager's guide to virtual teams*. Amacom Books, 2011.

[10]   T. U. Daim *et al.*, "Exploring the communication breakdown in global virtual teams," *International Journal of Project Management,* vol. 30, no. 2, pp. 199-212, 2012.

[11]   M. Bourgault, N. Drouin, and É. Hamel, "Decision making within distributed project teams: An exploration of formalization and autonomy as determinants of success," *Project Management Journal,* vol. 39, no. S1, pp. S97-S110, 2008.

[12]   R. M. Verburg, P. Bosch-Sijtsema, and M. Vartiainen, "Getting it done: Critical success factors for project managers in virtual work settings," *International journal of project management,* vol. 31, no. 1, pp. 68-79, 2013.

[13]   L. S. Henderson, R. W. Stackman, and R. Lindekilde, "The centrality of communication norm alignment, role clarity, and trust in global project teams," *International Journal of Project Management,* vol. 34, no. 8, pp. 1717-1730, 2016.

[14]   K. E. Nidiffer and D. Dolan, "Evolving distributed project management," *IEEE software,* vol. 22, no. 5, pp. 63-72, 2005.

[15]   N. Drouin and M. Bourgault, "How organizations support distributed project teams: Key dimensions and their impact on decision making and teamwork effectiveness," *Journal of Management Development,* vol. 32, no. 8, pp. 865-885, 2013.

[16]   J. Solomon, "Corporate governance and accountability," ed: John Wiley & Sons Inc, 2013.

[17]   PMI, "Governance of Portfolios, Programs, and Projects," 2016: Project Management Institute.

[18]   T. Hoefling, *Working virtually: Managing people for successful virtual teams and organizations*. Stylus Publishing, LLC, 2003.

[19]   W. Curlee, "Modern virtual project management: The effects of a centralized and decentralized project management office," *Project Management Journal,* vol. 39, no. 1_suppl, pp. S83-S96, 2008.

[20]   D. J. Rice, B. D. Davidson, J. F. Dannenhoffer, and G. K. Gay, "Improving the effectiveness of virtual teams by adapting team processes," *Computer Supported Cooperative Work (CSCW),* vol. 16, no. 6, pp. 567-594, 2007.

DOMAINS OF THE PROJECT MATRIX ORGANISATIONAL STRUCTURES IN THE PUBLIC SECTOR

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Abstract: *As problems and projects have become more complex, the inadequacy of the hierarchical organizational structure became apparent. At the same time, the necessity for designing the organization around the task to be performed was realized. Fortunately, varied but more complex organizational alternatives have become available. Meanwhile, project oriented approach has been rapidly increased also within public sector implemented policies where more and more activities is defined as projects or programs. In this paper author analyses project organisational structures and its practical application models in the public sector in Latvia.*

Keywords: project management, project organization, public administration, matrix organization, Latvia.

1. Introduction

Government and organizations usually embark on different projects with the aim of creating new service or improving the functional efficiency of the existing ones. All these projects require appropriate skills and techniques that go beyond technical expertise only, but encompass good and sound skills to manage limited budgets, and monitor shrinking schedules and unpredicted outcomes, while at the same time dealing with people and organizational issues [1]. The application of project management practice in public sector has been identified as an efficient approach which would help in upgrading management capabilities and enable public sector to efficiently complete projects and attain developmental objectives [2].

A matrix organization is defined as one in which there is dual or multiple managerial accountability and responsibility. However, the term matrix means quite different things to different people and in different industries [3; 4]. In a matrix there are usually two chains of command, one along functional lines and the other along project, product, or client lines. Other chains of command such as geographic location are also possible.
The **object of the research** is organisational structures of public sector projects.
The **aim of the article** is to evaluate project organisational structures and its practical application in the public sector in Latvia.
The **objectives of the article** are as follows:
- assess the public sector project management practice and identify the problem areas of public sector project organisational forms in Latvia,
- analyse theoretical background of project organisational structure concepts in public administration,
- provide proposals for public sector project organisation improvement.

The **research methods** used in the article include the project and program empirical data analysis and literature review as well as survey based on questionnaire.

The **research limitations**: in this paper author analyses most used organisational structure concept for the project management in the public sector of Latvia – matrix organisational structures. Due to the limitation author will not compare and analyse other project organisational structure models but will analyse specific problems and practical application of the matrix organisational structure in the public sector project management.

Matrix organisations combine elements of functional and project structures. Both project manager and functional department are given authority and control over project resources. As a result, "there are usually two chains of command, one along the functional lines and the other along project lines" [5]. The installation of two parallel authority structures frequently causes conflicts between project management and line management over the distribution of powers to make decisions, the allocation of resources and the integration of project outcomes into continuing operations [6; 7]. For example, the project manager is given the authority necessary to reach the project goals, including the delegation of tasks and responsibilities among project staff. The functional manager, however, usually defines personnel staffing and has authority over project staff in disciplinary matters [8].

Larson and Gobeli (1998) [6], the PMBOK (PMI, 2017) [9] defines three different forms of matrix organisations: weak, balanced and strong. Weak matrix organisations represent organisational structures where project managers perform work that is characterised by limited authority over project resources, monitoring of project activities and the provision of information on project progress to functional managers. In balanced matrix organisations, both project managers and functional managers are given authority and discretionary power for a project.

Finally, the responsibilities of project managers in strong matrix organisations include decisions regarding project staff, finance and other key resources. In strong matrix designs, functional managers' authority is confined to administrative tasks and supervision. Types and differences of matrix organisational structures is summarised in Fig. 1 (Source: Challenges and Strategies of Matrix Organizations).

FUNCTIONAL MATRIX	BALANCED MATRIX	PROJECT MATRIX
Employees remain full members of functional teams.	Employees officially belong to two distinct organizing dimensions.	Employees move between functional departments.
Project managers are limited to coordinating the efforts of functional groups.	Project managers are responsible for defining what needs to be accomplished when.	Project leaders have primary control over resources and project direction.
Functional managers are responsible for the design and completion of technical requirements.	Functional managers define personnel staffing and how tasks will be accomplished.	Functional managers serve a support or advisory role, and retain control over much of the team responsible for carrying out plans established by project managers.
Processes and procedures instituted to ensure cross-functional collaboration.	Strives for equalized power and authority between organizing dimensions and equal pursuit of multiple business objectives.	Permanent project management overlay.

Figure 1. Traditional forms of matrix organisational structures

To analyse more detailed project management practices within matrix organisation we need to look at project management practice in the public sector as itself. First we need to set a maturity level for the project management practices, identify project types and decision making processes.

2. Research

To analyse project organisational structures in the public sector we shall evaluate public sector project management capacity and maturity. Author asked respondents to undertake self-assessment and evaluate their organization capacity in project management. The study shows that public sector organization maturity is on middle/low level (Figure 2) [10; 11].

Project Management Maturity refers to processes, documentation, management and metrics. Author suggests five levels of project maturity management as follows:

Table I. Project management maturity levels

Maturity Level 5 (Highest)	Optimised processes (All project management processes are in place, measured and continually improved upon)
Maturity Level 4	Managed processes (All project management processes are in place and these are regularly measured)
Maturity Level 3	Organisational standards and institutionalised processes (majority of project management processes are in place and are used by the majority of people)
Maturity Level 2	Structured processes and standards (basic processes are in place and used most of the time)
Maturity Level 1 (Lowest)	Initial process (no or little formal and/or documented processes being used)

(based on author's questionnaire maturity description)

Research concludes that public sector bodies assessed their maturity as maturity level 3 – Organisational standards and institutionalised processes (majority of project management processes are in place and are used by the majority of people), quite big part of public sector organizations has identified their organizations in the second level of maturity – Structured processes and standards (basic processes are in place and used most of the time).

Authors has elaborated survey questionnaire for local municipality project management specialists. Questionnaire has been sent to all Latvian municipalities (in total 119), in the frame of study 97 responses has been collected (research sample is 97 out of 119, n=97).
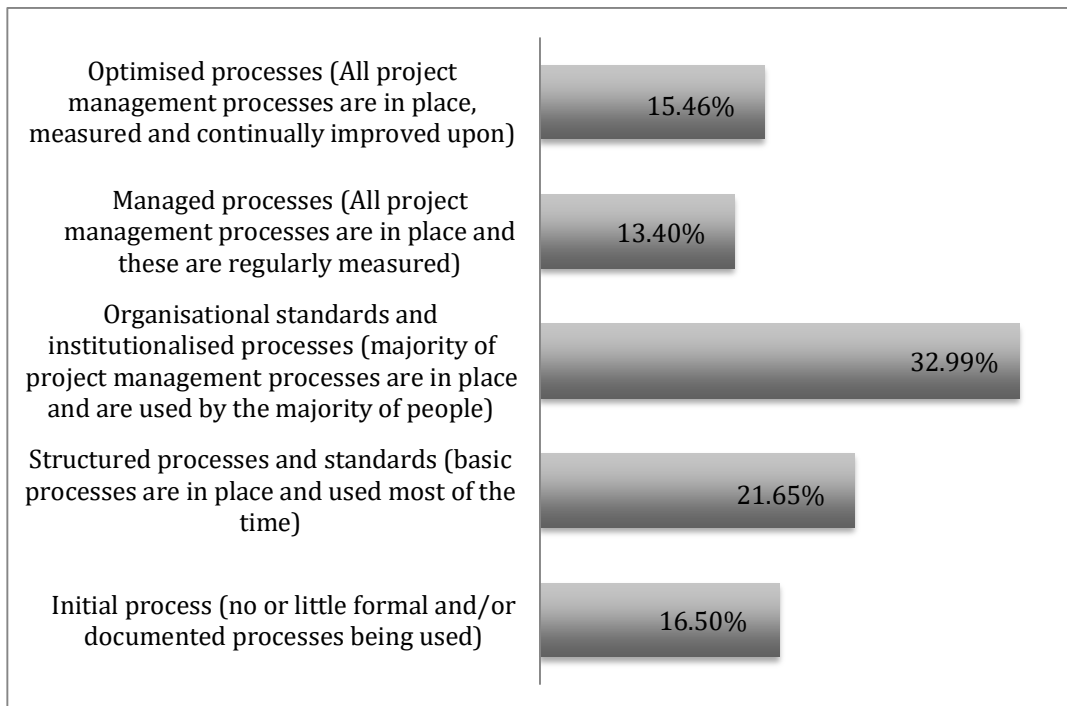
Figure 2. Public sector project management maturity self-assessment (n=119) (based on author's empirical research)

In order to obtain a mathematically reasonable view of the project planning capacity in the public sector - quantitative analysis of the survey data obtained through analysis of education, training and practical work experience aspect of the relationship with the real action methods. Quantitative analysis carried out in two steps: describing the central tendency and variation of parameters and in accordance with the empirical distribution with the normal distribution choice of parametric or non-parametric method for Inferential Statistics.

The author evaluated the public sector practice in project development and initialization processes in Latvia. In the frame of research evaluation of project problem and goal definition has been done.

2.1. Descriptive statistics - assessment of the human resources.

Also set of statistical indicators for the next questionnaire. The issue of human resource role of the arithmetic mean is 3.12. The median is 3, the mode is the third the standard deviation of human evaluation data is 1.184. Skewness coefficient is - .167, it means that a group of 100 people A_{apr} | - .167 | < .477 A_{crit}, which shows the empirical distribution with the normal. Kurtosis is − .698. K_{apr} 2.30 < $K_{lb - kr}$ 2,35 or 2,30 K_{apr} > $K_{ub - kr}$. 3.77. According to this indicator data empirical distribution does not meet the normal, which is illustrated in Figure 3. - The value of the frequency distribution shown in the histogram. Unlike previous issues of human resources respondents evaluated as important, considering that this is a problem not only affects certain aspects of the use of the project management methods, but it's essential and very important problem, which affects the ability and capacity of local governments in project design and implementation.
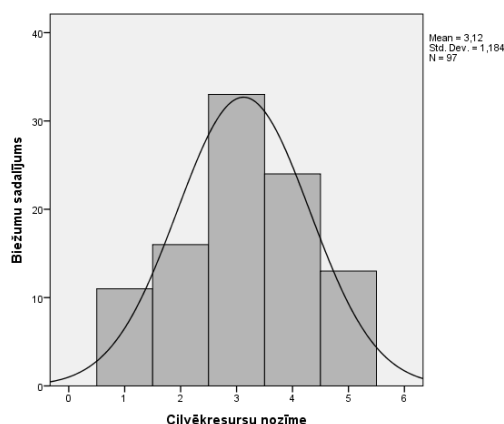
Figure 3. The frequency distribution of the view of the importance of human resources (based on author empirical research)

2.2. Descriptive statistics on employee initiative, lack of assessment.

The following parameters were considered in the statistical analysis - lack of initiative of municipality staff in project planning and implementation processes. The results show evidence that local government officials conditionally critical concerns for employees' responsibilities - in both the median and the mode is 3, but the arithmetic average is close to 3 (2.72). This means that most of professional's has lack of initiative and it's a factor that affects the specific project planning and implementation processes, however, refrain assess the lack of initiative as a very significant problem. A_{apr} 2.72 > 0.477 A_{crit}, which shows the empirical distribution of non-compliance with the normal. Kurtosis is − .615. K_{apr} 2.39 > $K_{lb - kr}$ 2,35 or 2,39 K_{apr} < $K_{ub - crit}$ 3.77. Although the fourth consecutive fall in the critical moment of the theoretical value within the overall results indicate non-compliance with the normal data distribution.

The histogram in Fig.4. shows that opinions about the lack of importance of employee initiatives grouped around the average values of the relative trend in the swing of the lower ratings that lack of initiative is not considered a major problem in project planning and implementation context.
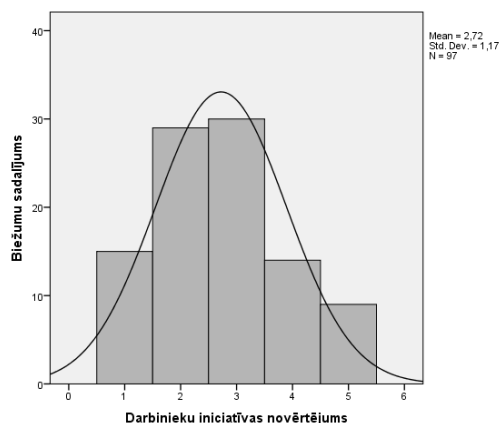

Figure 4. The frequency distribution for the lack of staff initiatives (based on author empirical research)

2.3. Descriptive statistics for the officials and politicians responsibility and understanding of project management methods

Statistically, describing the poll question on the officials and local politician's responsibility and understanding of project planning and implementation methods and their role, it was found that the arithmetic mean is 3.01. Median 3, and mode 4, a standard deviation is 1.36. Since the mode is 4, which means that most local government officials who were interviewed chose the answer - "A major issue that has affected the ability and capacity of local governments in project design and implementation". Asymmetry parameter is - .070 as $A_{apr.}$ |- 070|< $A_{crit.}$ .664 (p<0.05), it can be concluded that the empirical distribution corresponds to the normal distribution. Excess ratio is -1.264. So the fourth round figure obtained by adding 3 is 1.74. K_{apr} 1.74 < $K_{lb - kr}$ 2,35 or 1,74 K_{apr} < $K_{ub - crit.}$ 3.77 (p<0.05), therefore it does not meet the normal empirical distribution.

Fig.5. graphically displayed on the respondents' views of officials and politicians responsibility and understanding of project planning processes in local municipalities. The barriers to local project management specialists evaluated as the different views - ranging from the lack of contact with a similar problem - to the assessment that it's essential or very important problem. Moreover, this is a barrier that is considered to be very significant in relation to the research problem.
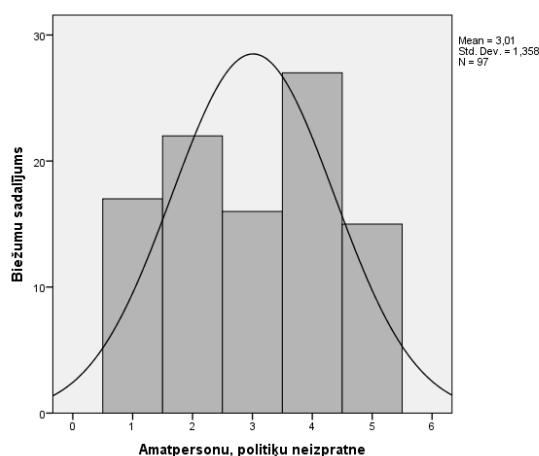

Figure 5. The frequency distribution for the incomprehension of officials and politicians (based on author empirical research)

If we analyse case of EU member state – Latvia, we shall take into account different aspects and application models of project management where mostly we need to separate so called EU funded project management versus project based policy implementations or projects who do not lie under the other financial instrument regulations. The European Fund for Strategic Investment (EFSI) and other regulated public sector project oriented investments has strong framework of laws and regulations while institutions own initiative projects has more flexibility. Currently there is 157 government institutions in Latvia 96% of those institutions has implemented or implementing project based activities, mostly different EFSI projects or other donor financed specific projects (76% of the institutions), while only in 16% of institutions project oriented approach for their policy implementations or development activities was chosen.

Increase of organisations projectification has raised also discussion on how to organize projects within institutions, how to manage and coordinate them. Analysing institution practices author concludes that projects usually are implemented within structural unit who is responsible for the policy field or who will benefit from the project results or within specific project management units or departments.

However separate unit or project management department not always means that there is clear project management methodology or set procedures or even better project management quality in general. Most of success is ensured by how the project management processes are organised, what organisational structures established, overall project management experience and professional knowledges. As discussed in literature most efficient project organisation would be pure organisational structure, however practice shows that in public administration we almost never seeing such approach, where only exception is large scale projects and long term projects (for instance RailBaltica project).

In general, public sector implements projects within matrix organisational structures where project manager is appointed for the specific project. Meanwhile project teams are usually build from the permanent personnel from the different organisational units, for instance, legal department and finance department etc. Aspects affecting the form of the project organizational structure is summarised in Table II.

Table II. Main aspects affecting the form of the project organizational structure.

Aspects	Description
Division of labour	Division of labour Labour should be divided among departments to ensure specialization. Dividing labour into distinct tasks and coordinating these tasks will define the structure of an organization
Background and experience	Background and experience Previous experience with project organizational forms
Interdependence and interactive management	The number of systems and subsystems that integrate the project, the different methodological and philosophical assumptions across these systems, the cross-organizational and schedule interdependencies between activities
Concurrent engineering	Concurrent Engineering breaks down functional and departmental barriers by integrating team members with different discipline backgrounds often known as cross-functional teams
Authority, responsibility, and leadership	Authority and leadership should correspond with responsibility. Vision, strategy, and a cohesive team are also considered key factors
Unity of command	It should be clear who the upper level managers are with well-established lines of commands. Every member of the project must also know what his obligations are
Personnel, professional knowledge, ethical norms	Good selection of personnel with adequate skills and talents, which can lead to objectives accomplishment
Stakeholders	The number of project participants and how the information flows between them can affect the form of the structure
Control and Monitoring	Work processes and systems should be efficient and effective with adequate levels of control
Flexibility	Structures should be flexible and dynamic with the ability to adapt to changing conditions of the external environment
Cultural values	Loyalty of workers and commitment to the project
Other but important aspects	Project scope and duration, environment and territory, technology

Unfortunately in the public sector not always project problems arise because of the organisational structure as excellent project management can be realised also within matrix organisational structures. Author research shows that this could be explained because of:

1) Lack of professional project management knowledge and skills;
2) Lack of top management understanding of project management;
3) Lack of project management methodology as well as non-existence of project management internal rules, regulations and procedures.

3. Problems of the Matrix organisational structure

The matrix organization does have some disadvantages and problems, but they need not be considered insurmountable. Knowing what problems may occur is "half the battle" in overcoming them. The following disadvantages are inherent in the matrix organization:

- *Two Bosses* — The major disadvantage is that the personnel on the project are working for two bosses. In any type of conflict situation a person could easily become "the man in the middle." Further problems of conflict can be caused by project personnel playing one boss against the other.

- *Complexity* — The matrix organization is inherently more complex than either a functional or a pure project organization, since it is the superimposition of one on the other. This complexity shows itself in the following problems:

- *Difficulties in Monitoring and Controlling* — Complexity results from the number of managers and personnel involved and from the number of people that must be kept informed. Fortunately, modern computer techniques have helped to keep this problem under control, but basically it's still a "people" problem.

- *Complex Information Flow* — This is a problem only because there are so many people and organizational units involved. Both the project and functional managers must be certain that they have touched bases with each other for any major decisions in their areas of responsibility.

- *Fast Reaction Difficult* — The project manager is sometimes faced with a problem of achieving fast reaction times, primarily since there are so many people to be consulted. The project manager in the matrix usually does not have strong vested authority, therefore considerable negotiation is necessary. Project management was primarily conceived to prevent this problem, but it can be a problem if the management system keeps the project manager from making any decisions without consultation with functional and top management. If the matrix is working, the problem won't occur.

- *Conflicting Guidance* — The more complex organization with two lines of authority always increases the possibility of conflicting instructions and guidance.

- *Priorities* — A matrix organization with a number of projects faces real problems with project priorities and resource allocation. Each project manager will obviously consider his project to have the highest priority. Similarly, each functional manager will consider that the allocation of resources and priorities within his department is his own business. As a result, the decisions involving project priorities and often the allocation of resources must be made at a high level. This often puts an undue and unwelcome load on the top executive officer in the matrix. This problem has led to the use of a manager of projects, or a super project manager in some organizations. His principal functions would be to consult with higher levels of management to assure equitable allocation of

resources and to periodically reassess project priorities. This effort can be extremely valuable in reducing conflict and anxiety within the matrix.

- *Management Goals* — There is a constant, although often unperceived, struggle in balancing the goals and objectives of project and functional management. A strong project manager may place undue emphasis on time and cost constraints, while a functional manager may concentrate on technical excellence at the expense of schedules. Top management must assure that a careful balance of the goals of both project and functional management is maintained.

- *Potential for Conflict* — As discussed in a later section of this chapter, whenever there are two project managers competing for resources, there is potential for conflict. This conflict may evidence itself primarily as a struggle for power. However, it also may evidence itself by backbiting, foot-dragging and project sabotage. Conflict and competition may also be constructive as an aid to achieving high performance; however, it cannot be allowed to degenerate to personal antagonism and discord. In project work conflict is inevitable; keeping it constructive is the problem in matrix management.

- *Effects of Conflict on Management* — Since conflict and stress are inherent in the matrix organization, considerable attention must be given to the individuals who will function as both project and functional managers. Individuals vary greatly in their ability to function effectively under stress. Conflict, particularly the role conflict typical of the two-boss situation, can produce stress, anxiety, and reduced job satisfaction. Considerable attention must be directed toward assuring that prospective managers have a high tolerance for conflict situations.

4. Results and Conclusion

Professional project managers in public administration play a crucial role in promoting and explaining the key principles of project and investment appraisal in their organizations, both to encourage long-term decision-making and to manage uncertainty and complexity. Two key challenges can arise that require their professional judgment. In the public sector most likely matrix organisational structure for the project implementation will be the first choice for any project because of project temporality. We can see increasing tendency that more and more policies are implemented as project based activities, but to ensure better quality of the project management within chosen project organisational structures author can suggest to follow those pillars:

1) Top management awareness and knowledge raising in the project management;
2) Attraction of professional and experienced project team members;
3) Continuing support and coordination processes within project teams and other involved structural units;
4) There should be clear rules and regulations for the implementing projects in the institution, as qualitative projects can be implemented only in qualitative environment.

5. References

[1] Archibald, Russell D., *Managing High-Technology Programs and Projects.* New York: John Wiley & Sons, 1976, pp. 14-15.

[2] Arnaboldi M., Azzone G., & Savoldelli A. (2004) "Managing public sector project: the case of the Italian Treasury Ministry", *International Journal of Project management*, 22(3), pp. 213-223.

[3] Abbasi, G. Y. and Al-Mharmah, H. (2000) Project management practice by the public sector in a developing country, International Journal of Project Management, 18, 105-109.

[4] Cleland. David I. and William R. King, *Management: A Systems Approach*. New York: McGraw-Hill Book Company, 1972, pp. 337- 362.

[5] Gray, C.F. & Larson, E.W. (2008). *Project management: The managerial process*. Boston: McGraw-Hill/Irwin.

[6] Larson, E.W. & Gobeli, D.H. (1989). Significance of project management structure on development success. *IEEE Transactions on Engineering Management.* 36 (2), 119–125.

[7] Corsten, H. (2000): *Projekt management*. OW Verlag, München, Wien 2000.

[8] Kerzner, H. (2009). *Project management: A systems approach to planning, scheduling and controlling*. (10th ed.). New York: John Wiley & Sons.

[9] A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Six Edition, Project Management Institute, ISBN: 978-1-62825-184-5, 2017.,

[10] Pūlmanis, Emīls. *Public sector project management planning and efficiency problems* / Emīls Pūlmanis // Project management development – practice and perspectives: third International Scientific Conference on Project Management in the Baltic Countries, 10-11 April, 2014, Riga, University of Latvia : conference proceedings / University of Latvia. Faculty of Economics and Management, Riga: University of Latvia, 2014. ISBN 9789984494708. P.183-198. *EBSCO Business Source Corporate Plus, Business Source International*

[11] Pūlmanis, Emīls. *Public sector project management application and sustainability problems: case of EU member state - Latvia* / Emīls Pūlmanis. References: p.31-34 // PM World Journal. ISSN 2330- 4480. Vol.3, N 11 (2014), p.1-35: fig. Databases of EBSCO Publishing, Inc

MANAGING THE DIGITAL TRANSFORMATION: ASSESSMENT OF KEY CAPABILITIES USED TO DRIVE THE DIGITAL TRANSFORMATION OF WELL-ESTABLISHED ORGANIZATIONS

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Abstract: *The global business is being impacted by technological disruption and the challenges to implement these kind of projects are increasing. The organizations are forcing their own capabilities to survive and keep up to date with the technological changes. This paper aim to conduct a literature review of the field of digital transformation; in addition, linking these topics to the adjacent fields of Change Management, Disruptive Technologies, and Project Management. By researching the relationship of Change Management, Disruptive Technologies and Project Management it becomes evident that a key success factor to manage the Digital Transformation is the inclusion of these academic fields. As result of the research, a conceptual framework is proposed with focus in the Self-Assessment cluster to determine the capabilities of the organization before the adoption of the Digital Transformation Strategy. The Self-Assessment does not guarantee the lack of risks, but it will help to mitigate them and thus have a smoothly digital transformation process.*

Keywords: Change Management, Digital Transformation, Disruptive Technologies, Project Management

1. Introduction

Digital Transformation is the most relevant term for many organizations. The digital age is forcing most of the companies to transform their organizations to keep up with all the current and upcoming changes in order to meet customer demands and the highly competitive market. In an attempt to do so, the organizations often undergo so-called digital transformation initiatives. Nevertheless, there is still a lack of common understanding of the meaning and impact of these initiatives for organizations. The different sectors such as private companies, government, researchers, education and many more are trying to find a common definition of the term and the impact. Nonetheless, the gap is not getting smaller. Digital transformation is challenging each sector and the level of uncertainties surrounded the topic is just growing. Although there are studies that describe the maturity models to measure the capabilities of how well or not well is an organization doing in digital transformation, there is, still not emerged a solid assessment to measure the current capabilities of the organization before the transformation. Many studies focus on organizations undergoing the change but only a few with focus on organizations starting with the transformation. This research aims to contribute to the understanding of digital transformation by identifying the elements that organizations should build up before starting with the change and thus measure the impact of such initiatives within the organizations. The first goal is to develop a better understanding of the meaning of Digital transformation and the possible impact in well-established companies. In addition, link the term with adjacent fields such as Change Management, Disruptive Technologies, Innovation, and Project Management.

2. Objectives

The two main goals of this paper are:
• To develop an understanding of the importance of digital transformation concept in organizations and the implications of the topic and relate it to adjacent concepts such as disruptive technologies, change management and project management.
• To propose a framework that aims to determine if the organization has the capabilities to start with the implementation of digital transformation. As part of the scope of this paper, only the cluster "Self-assessment" will be explain into details.

3. Literature review

3.1 Introduction and supporting literature
The structure of the literature review can be described as follows:
1. Introduction and supporting literature: short descriptions of systems theory, models and, general concepts.
2. Digital Transformation literature: systematic review of the current state and concepts of digital transformation in the current literature.
3. Links to other academic fields: change management, disruption, innovation, and project management.

3.2 General literature
There is no clear definition for the German economy of the term well-established or large organizations. Mittelstand commonly refers to small and medium-sized enterprises in German-speaking countries, especially in Germany with annual revenues up to 50 million Euro and a maximum of 499 employees. Nevertheless, the multinational organization Robert Bosch claim to be part of the Mittelstand (Langenscheidt & Venohr, 2015). After reviewing the literature, well-established organizations or large organizations are opposed to the Mittelstand.

3.3 Digital Transformation
The term "digital transformation" have existed at least since 2000 [12]. There are many definitions surrounded the term and the concept of digital transformation is on a high level easily understood: the use of technology to transform business, society, economic and the individual.
During the literature review of the phenomenon of digital transformation, there are many definitions and authors trying to understanding the meaning. One of the concept is the one of the author of the book Digital Master. The terms "transformation" and "change" truly overlap in literal definition; people tend to carry their own associations with each. Transformation is definitely the more ambitious sounding term, and organization's digitalization is surely a transformation journey; it has to permeate into business vision and strategy, mind-set and action, culture and communication, process and capability (Zhu, 2015). [15] define digital transformation as "the use of technology to radically improve performance or reach of enterprises". Another well-known, more holistic definition for the term is that "digital transformation can be understood as the changes that digital technology causes or influences in all aspects of human life" (Kaplan, 2010). Another interesting definition by Lankshear and Knobel (2008) defines digital transformation as the third and ultimate level of digital literacy that "is achieved when the digital usages which have been developed enable innovation and creativity and stimulate significant change within the professional or knowledge domain". [8] describe digital transformation as a significant shift in the business operations, products, processes and organizational structure of a company which accompanies its initiatives to make use of digital technologies. One more is the one of [13], digital transformation is not about technology - it is about strategy and new ways of thinking. After reviewing all the existing concepts of digital transformation, the concept below was constructed:
Digital transformation is an ongoing journey with impact in the way organizations, society and individuals behave and respond to digital technologies. It requires a holistic view and a change in the strategic mindset of any organization.

3.4 Disruption

For many, the need to re-think, re-design and adapt their organizations arises in response to a fear of a different, the unknown. Dire outcome: disruption. Digital transformation is rewriting the rules of business. These new rules have created opportunities but also countless new challengers to take in well-established organizations. According to the author Rogers, disruption has become a buzzword, bandied about indiscriminately. Business disruption happens when an existing industry faces a challenger that offers far greater value to the customer in a way that existing firms cannot compete with directly [13]. Disrupt or be disruptive are the options for organizations. No industry is immune. If the Industrial Revolution was about machines transforming nearly every physical act of labor and value creation, nowadays, organizations are at the beginning of a revolution in which computing will transform nearly every logical act of value creation [13]. Marc Andreessen has famously said that ''software is eating the world''. He invented the first Web browser, the software that unleashed the Internet as a network for mass participation. If software is eating the world, Digital Transformation is guiding organizations in a world of uncertainties not every year but every day.

3.5 Disruptive Technologies

A disruptive technology is one that displaces an established technology and shakes up the industry or a groundbreaking product that creates a completely new industry [1]. Christensen [1] separates new technology into two categories: sustaining and disruptive. Sustaining technology relies on incremental improvements to an already established technology. Disruptive technology lacks refinement, often has performance problems because it is new, appeals to a limited audience and may not yet have a proven practical application. According to the Project Management Institute (PMI), all the new technologies emerging or existing such as Internet of Things (IoT), Artificial Intelligence (AI), Cloud Computing, Robotics and many more are part of the definition of Disruptive Technologies. All of them take part (trigger) of the disruption of many organizations. Christensen's theory of disruptive technologies is one of the most popular for explaining the plight of the incumbent firm facing a significant new technology. He proposes a theory of response to disruptive technologies in two books about innovation [1]. He argues that investing in disruptive technologies is not a rational financial decision for senior managers to make because, for the most part, disruptive technologies are initially of interest to the least profitable customers in the market [1]. [16] present a framework for dealing with disruptive change that focuses on resources, processes and values. The term disruptive technology is young in the literature and there are only a few authors trying to understand the topic. It is very important to note out that authors like Christensen are not focus in one particular technology like the Internet of things (IoT), Artificial Intelligence (AI) and many others growing day by day. The focus of the author is to analyze the impact of the implementation of these technologies in organizations. Therefore, he proposed a framework with elements such as resources, processes, and values to have a better understanding of the implication of any disruptive technology project. The author argued the need to analyze the elements stated before – resources, processes, and values- as part of the adoption of any disruptive technology during the digital transformation journey of the organizations.

3.6 Change Management

For the purpose of this paper, the model developed by Lewin for change management is take it as a base. There are many models concerning organizational change, but the Lewin model is taken as a base due to the simplicity of the model. The part of change management can change from organization to organization; this can be influence not only due to the size of the organization but also due to the maturity of the organization. A different model will be complex to address for some organizations. The key point of change management as part of the development of this framework is to show the need of change and thus create an awareness of change management as part of the implementation of digital transformation. The digital transformation is a set of a wide range of changes for the whole organization; therefore, a change process should be incorporate to

manage a smooth change. The Kurt Lewin change theory model (Lewin, 1947) is base around a 3-step process (Unfreeze-Change-Freeze) that provides a high-level approach to change.

3.7 Project Management

Digital transformation is not one project within an organization. The reason of why Project Management is part of the developed of the framework is to use it as a good practice during the digital transformation. The project management is a guide of phases, tools and methods to create a solid foundation during the transformation journey. For the purpose of this paper, the project management body of knowledge (PMBOK, 6th edition from the Project Management Institute (PMI) is being used. Using the PMBOK as based does not imply that is the only one that can be use but at least is one of the most structure frameworks to start working on. The ideology of the PMBOK is process-based, therefore will add value to the structure of the developed framework. As stated before, researchers, organizations, public government and many more are trying to find a common understanding of the implications of the digital transformation. Right now, the common understanding is that the power of a digital transformation strategy lies in its scope and objectives (MIT Sloan Management Review & Deloitte [17]). Even if the digital transformation should not be treat as one project, should share the fundamental principles of project management like a clear definition of scope and objectives.

After an extensive literature review of different fields, the predominant adjacent fields of the digital transformation are the ones mentioned above disruption, disruptive technologies, change management and project management.

4. Analysis and Discussion

The purpose of this is to review the current definitions and frameworks of digital transformation and describe its diverging nature in the current academic discourse. The theory of current frameworks to understand the digital transformation approaches is being used to be able to build the framework. One of the theories to construct the framework is the five domains of digital transformation: customers, competition, data, innovation and value preposition used by [13]. The author proposed five domains how digital is changing and organizations should take a closer look at. One more model is the one of [15]. The model of the authors is divided into two streams of digital capabilities: customer experience, core operations (processes), reinventing business models and leadership capabilities (digital vision, engaging organization, governing transformation and building technology). In addition some frameworks proposed by different consultancy companies such as Accenture, Deloitte and, McKinsey. Moreover, different research papers from Gartner and Fraunhofer research center were also evaluated to build up the framework.

The Figure 1 represents the assessment method developed.

Figure 1. Assessment method (own model)

4.1 Transformation Management

Managing a well-established company in the digital age is not easy. Hence, a high engagement from the management during all the transformation is required to succeed. It is necessary to fix the basis, have a strong alignment among department and collaborate to determine the target of the company in the digital transformation journey. Many companies are creating a unique division to manage the digital transformation. This was the case of Starbucks. According to many case studies, it is a good practice to start with a division; nonetheless, the process should be aligned with all the departments of the organization, not only IT, not only business but the whole organization. As part of the governance, the management should be involved during the entire journey to steer the wheel to keep the transformation on the right track. The elements of this driver are digital leadership, governance, engagement and digital shared vision.

4.2 Organization Culture

The organization culture is a process that can take years since involve the mission, vision, beliefs, processes, and way of work of the individuals. Organization culture is a key element since is one of the main pillars to be able to adopt the digital transformation journey. The organization should engage all the employees with the transformation. When employees are engaged in a shared vision, they help to make the vision a reality and support the management during the entire journey. As part of the engagement, the organization can incorporate a set of initiatives to make feel everyone as part of the change and foster a culture of collaboration. According to George, Didier & Andrew in their book leading the change, some well-established companies such as Starbucks and Codelco implemented some contest to foster a culture of change and awareness of the transformation. The elements of this driver are change in mindset, foster agility, collaborative skills and knowledge sharing.

4.3 Innovation

The term innovation has been evolving for the past years. According to [13], innovation is any change to a business product, service or process that adds value. The change can be an incremental improvement to the creation of totally new and unprecedented. In the digital age, organizations need to innovate in a radically different fashion, based on rapid experimentation and continuous learning rather than concentrating primary on a finish product; this approach focuses on identifying the right problem and then developing, testing, and learning from multiple possible

solutions. During the digital age, innovation is not only about the word new but also evolving, changing, refining, adding launching and testing solutions to satisfy the need demand of the customers. As Scott Anthony say, innovation is not just about "big bangs"; it is about anything new that has impact and can add value. As digital technologies make it easier and faster than ever to test ideas, this new approach to innovation is essential to bringing new ideas to market faster and with less cost, less risk, and greater organizational learning. The elements of this driver are adding value through innovation and Trends and insights: Innovation opportunities.

4.4 Alignment Business & IT
Digital transformation is about re-thinking and re-building the way the organization has been working for years. As part of this process, the communication with the business should be change to a strategic one. For the past decades, IT is known as infrastructure provider, as part of the change. Nowadays, there is demand to see the role of IT to service provider which can offer a wide range of service and not only the technical one. The alignment of business is critical to build up solid foundations and follow one same goal, one same direction during the transformation journey of the organization. The elements of this driver are customer experience, customer relationship and ranking priorities.

4.5 Re-inventing Business Model
According to [13], companies can expect to compete with more and more businesses that do not look much like them. This was not possible a decade ago but now is the reality for many organizations. Therefore, to challenge the current business model and re-invent it to a digital business model is not optional but a must. The explosion of digital technologies offers many opportunities for innovative business models and value propositions. Many authors in the current literature address that customer will create the value such as business like Airbnb or Uber. These digital platform businesses operate with the basic in order to allow their customer to create their own value. Business model reinvention sometimes involves radically shifting what you sell, how you sell it, or how you make money of it. The three main reasons for reinvention of the business model are the creation of new value chains, shifts in the competitive landscape and today's exponential technological innovation that is continually challenging with opportunities and threats [15]. It can represent a challenge for conservative organizations to change their business model. However, as stated before, disruption is here, therefore well-established organizations need to exploit new digital resources by developing new capabilities and challenging their present value propositions to change their business model from a traditional business model to a digital business model to be able to satisfy the internal and external demand. The elements of this driver are identify emerging threats and opportunities in the value preposition and disrupting business model.

4.6 Technology Investment
Advances in digital technologies are fueling the rise of new. But, what about the current ones? As starting point, organizations should address some questions like where are we? What do we need? Which are the main priorities? How can we link the current initiatives with the future ones? Digital transformation does not mean to start from zero, it means to take the current initiatives and be able to integrate them in one single landscape. The organizations should also evaluate carefully through prestudies the right technologies for the organization. Disruptive technologies are a big set of different trends, one of the biggest mistakes is take one technology just because is a trend in the market and not because it will solve a need of the organization. An analysis of the profitable is fundamental to make the right choices. The elements of this driver are linking current & future initiatives and analysis of the profitable.

4.7 Talent and Skills
Organizations that want to push beyond the status quo must put renewed focus on the role of available talent and skills. It is a critical factor to develop the internal talent and be able to capture

the external one. In addition, there is a need to develop a ''learn fast'' mentality within the organizations. Nowadays, it is not about the current knowledge, the main value is related to the ability to learn and adapt fast to the environment. Organizations must build and maintain effective systems for sourcing and hiring workers, for establishing and evolving career paths, and for fostering continuous learning opportunities and a culture of growth. The elements of this driver are creating a learning culture, employee journey, allocating talent and treasure and, empowering talent.

4.8 Data Capability
As Gil Elbaz Putsite stated in their quote "The world is one big data problem", the data can become a big problem for organizations if it is not treated in the right way. Digital transformation operations require a strong technology backbone that integrates and coordinate process and data in the right way to increase the efficiency and effectiveness in the whole organization. One of the key factors is the ability to integrate the data to make better decisions and thus be able to create a better value. It is important to highlight that the term data goes beyond "Data mining" or "Big Data", the term data capability refers to the ability of the organization to re-design the processes according to the needs of the business, customers and have a harmonization of digital processes to foster productivity, efficiency and agility. The data should be seen as one of the most important assets of the organization since is the base to create and improve the existing and upcoming operational processes. The elements of this driver are harmonization and digitization of processes, data integration, data as strategic asset and bridging silos.

4. Conclusion and Future Research

Meeting the Challenges Continuous disruption is the new normal and Digital Transformation relies on an organization's ability to integrate rapidly evolving technology and tools. Even extremely successfully, companies built in the pre-digital age struggling to adapt their strategic thinking in order to thrive and grow in the digital age. Digital transformation is not a simple topic and there are still many uncertainties surrounded. The Self- Assessment can offer well-established organizations a guide to know their own capabilities and be able to plan better their potential ones. Reinventing and reimagining organizations during the digital age requires big challenges. It requires thinking differently about every aspect of the strategy - Transformation Management, Organization Culture, Innovation, Alignment IT and Business, Reinventing Business Model, Talent and Skills, Technology Investment, Process Harmonization, and Data Capability. As future research, a case study based on an organization is in process to use the key drivers to assess the capabilities of the organization.

5. References

[1] Christensen, C. *The innovator's dilemma*. 1st ed. Cambridge: Harvard Business Review Press, p.56. 1997
[2] Deloitte Insights. *Strategy, not technology, drives digital transformation*. Available at: https://www2.deloitte.com/insights/us/en/topics/digital-transformation/digital-transformation-strategy-digitally-mature.html [Accessed 22 May. 2019]. 2019
[3] Building your digital DNA Digital transformation in progress. Available at: https://www2.deloitte.com/content/dam/Deloitte/be/Documents/technology/deloittedigital/Deloitte-Digital-BE_Building-your-digital-DNA_download_HR.pdf [Accessed 10 May. 2019]. 2018
[4] Dobbs, R., Manyika, J. and Woetzel, J. *No ordinary disruption*. 1st ed. New York: Public Affairs, p.40. 2016
[5] Digital Transformation: Changes and Chances. Available at: https://www.fim-rc.de/wp-content/uploads/Fraunhofer-Studie_Digitale-Transformation.pdf [Accessed 30 Aug. 2019]. 2019

[6] Garrett, R. and Neubaum, D. Top Management Support and Initial Strategic Assets: A Dependency Model for Internal Corporate Venture Performance. *Journal of Product Innovation Management*, 30(5), pp.896-915. 2013

[7] Jones, M. Sustainable organizational capacity building: is organizational learning a key? *International Journal of Human Resource Management*, 12(1), pp.91-98. 2001

[8] Matt, C., Hess, T. and Benlian, A. Digital Transformation Strategies. *Business & Information Systems Engineering*, 57(5), pp.339-343. 2015

[9] Matt, C., Hess, T., Benlian, A. and Wiesbock, F. *Options for Formulating a Digital Transformation Strategy*. AIS Electronic Library (AISeL). Available at: https://aisel.aisnet.org/misqe/vol15/iss2/6/ [Accessed 10 Aug. 2019]. 2019

[10] Narver, J. and Slater, S. *The Effect of a Market Orientation on Business Profitability*. Journal of Marketing. Available at: http://dx.doi.org/10.2307/1251757 [Accessed 8 Aug. 2018]. 2009

[11] Parry, W., Kirsch, C., Carey, P. and Shaw, D. Empirical Development of a Model of Performance Drivers in Organizational Change Projects. *Journal of Change Management*, 14(1), pp.99-125. 2013

[12] Patel, K. and McCarthy, M. *Digital transformation*. New York: KPMG/McGraw-Hill. 2000

[13] Rogers, D. *The digital transformation playbook*. New York: Columbia University Press. 2016

[14] Schumpeter, J. *The theory of economic development*. Cambridge, Mass: Harvard Univ. Pr. 1955

[15] Westerman, G., Bonnet, D. and McAfee, A. *Leading Digital*. Boston: Perseus Book LLC (Ingram). 2014

[16] Christensen, C., Overdorf, M. Meeting the challenge of disruptive change. Harvard Business Review, 78/2, 67-76. Available at: https://www.researchgate.net/publication/ 215915528_Meeting_the_Challenge_of_Disruptive Change [Accessed 10 October 2018]. 2000

[17] Westerman, G., Bonnet, D., & McAfee, A. MIT Sloan Management Review. Available at: https://sloanreview.mit.edu/article/the-nine-elements-of-digital-transformation/. [Accessed 17 October 2018]. 2014

BLENDED LEARNING IN THE CONTEXT OF PROJECT MANAGEMENT: FOREIGN LANGUAGE COMPETENCE ACQUISITION

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Abstract: *Communication presents an essential topic in the context of project management since the manager spends the most of the working time in activities related to information exchange among project's stakeholders. The essence of communication is the signal, transferred between a sender and a receiver. This signal is usually accompanied with definite noises, which should be eliminated in order to get the pure meaning of the original message and, hence, the common understanding. To get a common sense, not only the professional language matters but the language settings in general: first of all, a sender and a receiver should properly understand each other.*

Considering a project management career, before its start, the students should possess knowledge related to professional terminology in the working language of the company. The process of learning the language in the field of professional communication is limited by the workload of a study program. Therefore, to speed up this additional educational process the suitable approach for this context has to be designed. For that, the blended learning concept can serve as a trigger to boost the professional start in project management career.

In this paper, several trends of blended learning are considered and analysed, based on the survey conducted among project management master students. During the analysis, best practices to learn a foreign language in the particular environment were selected to be included into the proposed blended learning concept.

Keywords: blended learning, project management, language competence, communication

1. Introduction

The entrepreneurship world is becoming projectized. The need to run business as projects determine the job growth in project management (further PM) area and therefore effective education and training measures of project practitioners are highly demanded [1]. Communication is claimed to be the main activity running through the PM domain: a project manager spends around 90 % of their time while communicating project information among stakeholders [2]. The European Master in Project Management (further EuroMPM) program aiming at teaching students from different countries is taught in English whereas its scope lies in Europe, hence, there is a need to learn the terms of PM in European and other languages in which the future PM practitioners are supposed to work. The blended learning (further BL) concept presented in the paper, is supposed to cover the issues of obtaining the knowledge of PM concepts in the language different from native.

2. Theoretical Background

Communication plays an extremely important role in PM. As it claimed by [2] communication is the subject of 90% of project manager's activities. [3] underlines that effective stakeholder' communication is the backbone of project success, whereas communication issues build up to 74% of the issues in distributed projects.

Basic communication model is described from the point of view "sender - message - receiver", and message when going through medium is normally accompanied with noises [4]. These noises build barriers to transmit and encode the message. Language as a barrier together with cultural differences was addressed by [5] in the sense that not sharing a common language and culture prevents effective communication.

[6] addressing the issues of intercultural business communication strategy proposes a conceptual model of the strategy creation with listing all the elements which build business, intercultural and communication strategies. Accordingly, the language element belongs to communication strategy's set and further author underlines the importance of possessing a common language by business partners and not experiencing additional noises caused by interpretation's dynamic.

[7] propose a cross-culture communication model where the elements of language, culture, environment, workforce and technology play the role of barriers between companies from different countries. Here authors relate to language as a country-specific one and underline the need to create a new language if the companies don't want to use the language of one of the companies.

From the PM perspective, [8, p. 178] underlines the importance of communication skills, meaning that the project manager should "write and speak in using a level of language expected of leaders".

[9, p. 69] points out the need to possess sociolinguistic competence, which is formed by language and communication competences, which is extremely important in frames of international management teams since it enables "communicating across languages".

Coming to the field of management skills, [1, p. 44] determine next skills as leading: communication, project teams' motivation, relationship management, enthusing passion, commitment in project members, team working skills, understanding the project context, problem solving, people influencing, public speaking persuasively, organizing and running a meeting effectively, employees' development fostering, their performance evaluating.

To address the issue how else the educational system can be rethought, the BL concept can be introduced especially in terms of possibility of obtaining knowledge practically.

BL is claimed as the tool to "blend" time, place, people, resources and activities [10], that means that learners and teachers can effectively and efficiently use the resources to deliver learning and teaching results with the combination of Information and Communication Technologies (further ICT). This approach covers the learning ways explicitly, especially in terms of theoretical and practical knowledge obtaining.

Following the Bloom's taxonomy [10], the BL activities can be allocated to levels of learning: remembering, understanding, applying, analysing, evaluating and creating. In this taxonomy, simulation games are assigned to the applying level of learning, but in the same resource, the simulation is affirmed as creative and active learning approach that enables people to remember 90% "what they do" [10, p. 25].

Mentioned above authors [1], in the ways how leadership skills can be trained, several times reference simulation games. These simulators can be defined as part of serious games (games aimed to train people through the stated goals), and represent "a digital imitation of something real that has game characteristics: competition, rules, etc." [11, p. 14]. All in all, we need simulators to reproduce the reality when the activities cannot be executed in real scenarios. At the same time, gamification itself is claimed as a powerful innovative motivational tool [12] that plays a significant role in engagement of students into knowledge obtaining.

Gamification is also a core idea of the BL approach applied by [13]. The BL concept proposed by authors considered both face-to-face lessons and the prototype of application for learning Chinese language. Scholars underline the importance to measure the progress of the learner, so the user will be aware what lesson needs to be learned further.

[14] consider the development of the software application to facilitate foreign language learning by appropriate approaches to train reading and speaking. Authors develop a prototype of such a program to learn English language and the results of its application proved the positive influence on learners.

Research conducted by [15] in 2015 in Poland serves for the current research as a reference point since the authors put the focus on non-native speakers studying either in Polish or English languages. The bilingual concept supported by virtual learning environment within ICT, including lectures, workshops as well as E-workshops, aimed at teaching first-year students the course in "Electronic data interchange". Besides, the bilingual online course provided the students with the opportunity to conduct online discussions with lecturers and to receive an official certificate after the successful course accomplishment.

[16] design a learning system to boost the knowledge acquisition through the Multilanguage BL environment using several integrated web-based translators. The translation was provided from English to other languages, with the testing of translation from English to Thai language for the contest of agriculture science.

3. Research Methodology
3.1 Research Questions

The main objective of the research paper is the development of BL concept, which will help master students to learn deeper the concepts and terminology in PM in the language required for their professional career. Based on that, the follow-up questions were formulated:
1. Which BL elements do students find useful for learning foreign languages?
2. How to use the advantages of these elements to build a concept of the platform for learning languages, based on the BL approach?
3. How to align this concept with education methods in PM area?
To answer the above-stated research questions, the following survey was designed (Table 1).

TABLE I. The questionnaire used for the survey

Question	Possible answers
Please select your age range:	20-25; 26-30; 31-35; 36-40
In which language do you plan to work as a project manager? (please choose a language of your first priority)	English; German; Spanish; Russian; Other (specify)
How is important for you to know special PM terminology in this language?	[Extremely; Very; Somewhat; Not at all] important
Do you find the blended learning approaches useful for language learning?	Yes; No
Which BL elements do you find useful?	Video streaming; Podcasts; Playing games; Other (specify)
Which language learning application(s) have you already used?	Duolingo; LinguaLeo; Babbel; HelloTalk; Other (specify)

The age range was predefined according to the average distribution of the age values among master students. Before starting with the main part of the survey, it was significant to determine which languages are of the highest priority in regard to future career. The selection of languages was based on the analysis of the most widespread ones according to the national composition of the master student groups.

Additionally, it was essential to identify whether master students, in general, find the BL approach useful for the learning process. In case of the positive answer, they were asked to specify which elements of this approach showed the highest effectiveness for them. Moreover, it is known that nowadays there are multiple applications connected to the idea of BL education especially in terms of learning a foreign language. Therefore, as a final question of the survey, it was enquired for giving information on mobile applications which students have already used for such purposes.

3.2 Limitations and Delimitations

Main limitations of the research were related to the BL methodology, specifically in the PM area. Since the further proposed concept is being developed for the first time, testing process was another constraint. In other words, once the concept is developed, it is also necessary to check its performance in practice and conduct the follow-up survey to gather feedback and impressions of its efficiency and usefulness what was impossible due to the initial stage of the research. Besides, the data collection was limited by the amount of participants as the concept presented in this article focuses mainly on students of PM study programs. Considering this fact, it also limits available competences and finding an appropriate instructor for the suggested approach.

As for the research delimitations, EuroMPM students were selected as the respondents of online-survey due to their availability and accessibility. Aside from that, choosing the language for developing further concept was of high importance. Such criteria as necessity to know a certain language and the career opportunities it can open are identified by country of studies and future professional plans. In this case, German was the language of priority regarding better job chances and preferences of the study focus audience.

3.3 Data Collection

The process of choosing an appropriate approach for this research included the decision on and preparation of the data collection methods best suited to the purpose of the research questions. In this case, online-survey tool was selected to offer a complementing measurable component in form of quantitative research method. This method of data collection has multiple advantages such as access to individuals in distant locations, the ability to reach difficult to contact participants, and the convenience of having automated data collection, which reduces researcher time and effort [17]. The online survey was conducted with the help of Google Forms, what is a free online tool that allows collecting information efficiently and easily. Besides, this survey tool automatically provides the graphical representation of questionnaire results.

3.4 Participants

The study targeted EuroMPM students who were able to give a brief information on their experiences and preferences related to BL methodology and its effectiveness. 35 participants were selected not just from the perspective of the study area but also covering the variety of different study semesters from second to sixth. Students in the survey come from around 20 countries.

4. Results and Discussion
4.1 Survey Analysis

According to the results of an online survey, the majority of EuroMPM students belong to the 20 to 25 age group. A total of 31 percent of the survey participants is of age between 26 and 30, while a quarter of respondents are between the ages of 31 and 35 (Fig. 1).
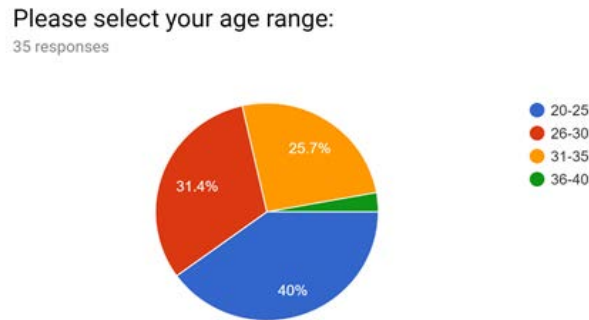

Figure 1. Age ranges among survey participants

Students in their late thirties are over-represented in the survey sample. These figures may reflect a general trend towards a small or no experience working in the area of PM which is accelerating the need for new recommendations on increasing the chances of getting the first jobs.

Further, participants were offered several languages to choose as their future working language in PM area. 1st and 2nd places are shared between English and German, respectively. Other options were of minority (Fig. 2).
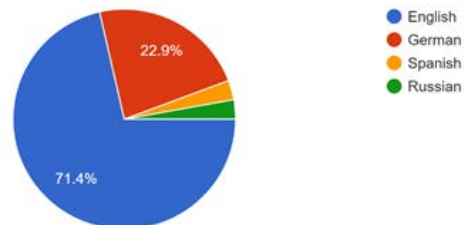

Figure 2. Selection of the future working language in PM area

The next question was related to identifying the level of importance to know special PM terminology in the chosen language. As a result, almost all respondents stated that it is either extremely important for them (51,4%), very important (42,9%) or somewhat important (5,7%). There were no "not at all important" replies found (Fig. 3).

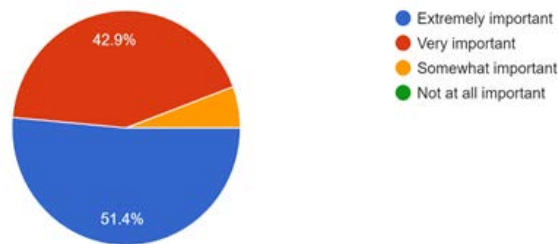How is important for you to know special PM terminology in this language?
35 responses

Figure 3. Level of importance to know PM terminology in the working language

It becomes evident, how essential for EuroMPM students to know special terminology used in the PM field. Since German is a second priority with respect to the working language, it determines the focus of the future concept development and identifies research delimitations.

Apparently, a certain learning approach should be selected in regard to the objectives, particular characteristics and main challenges of the study area. Based on that, BL methodology was proposed to the participants to be assessed in terms of its efficiency and usefulness. These criteria were confirmed among 91% of respondents, which fully justifies further research in this direction (Fig. 4).

Do you find the blended learning approaches useful for language learning?
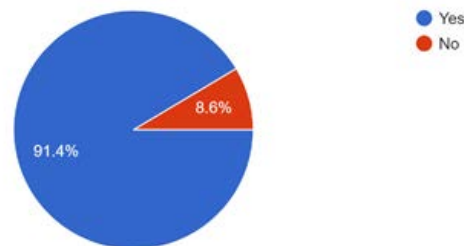35 responses

Figure 4. Usefulness of BL approach for language learning

Additionally, such BL elements, as video streaming, podcasts and playing games were ranked on the basis of their helpfulness (Fig. 5).

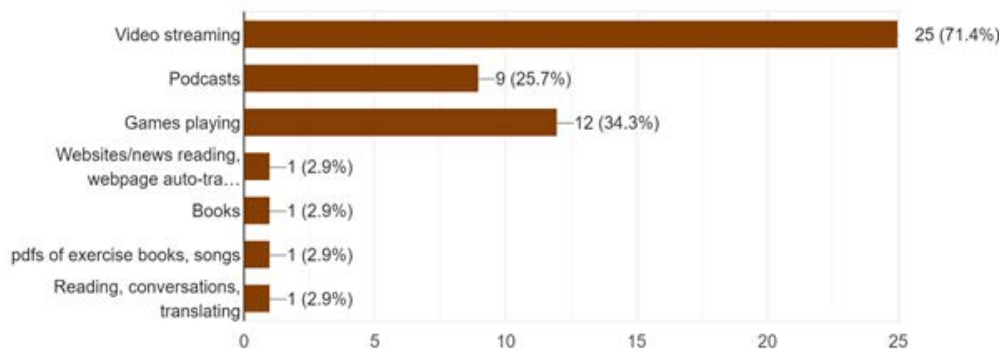Which BL elements do you find useful?
35 responses

Figure 5. The most useful BL elements

While watching videos on study topics is of the highest interest, the share of respondents that rated games as a useful BL tool is higher than those who preferred podcasts. Additionally, there was a chance to add any other BL elements to the proposed ones. In response to that, books, songs and news websites were suggested as possible alternatives for BL approach by survey participants.

Final question addressed the subject of language learning applications which had been already used by students (Fig. 6).

Which language learning application(s) have you already used?
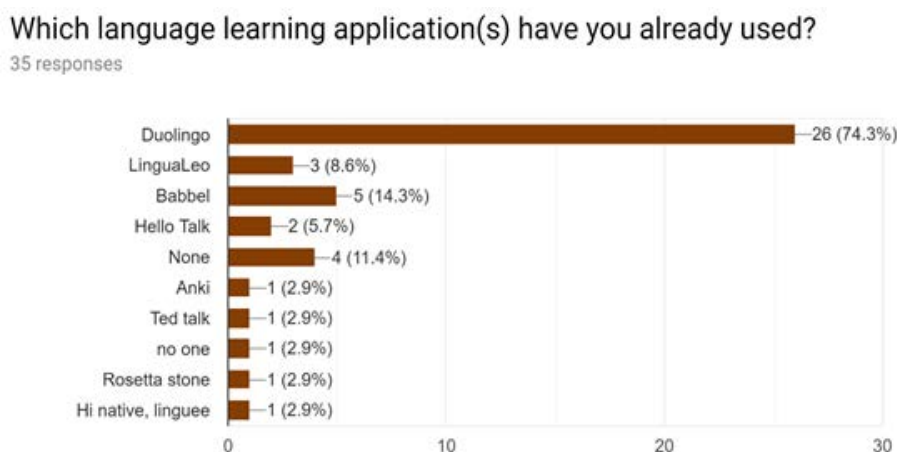35 responses

Figure 6. The most popular language learning applications

Duolingo language-learning application/platform took the 1st place by a wide margin. Such other options, as LinguaLeo, Babbel and HelloTalk are considerably less used. However, EuroMPM students added their own recommendations related to language learning applications, which were Anki, Ted Talk, Rosetta Stone, HiNative and Linguee.

The above-mentioned findings not only prove validity and relevance of the study, but also provide new insights for building the concept of learning PM concepts in a foreign language based on BL approach.

4.2 Literature Discussion

In the observed literature the language component was several times treated as a barrier or noise. When working with relevant literature we found limitations of addressing the language issues in PM field. Since communication is the most important part of project manager's activities, the language competence should be considered as an enabler of an effective communication.

The scholars address the issue of the BL concepts applied to language learning. In the literature observed the scholars apply these concepts to education in informatics, agriculture and purely in language competence acquisition.

Several authors proposed to use both face-to-face and ICT-based approaches to increase the knowledge gaining. For the current research the most valuable was found the research conducted in Europe among first-year students who were studying in non-native language.

The less value presented the paper about Multilanguage BL environment since it did not present novelty and results proving the efficiency of the proposed approach.

4.3 Concept description

In this paper the BL concept will be developed and described as a leverage tool to foster language skills of future project managers. The target audience for whom this concept should be implemented is presented by the students in the second semester of the EuroMPM program. The reason behind is that the standard master program is covered by four semesters only and the opportunity to work on the language skills during this program is limited by two semesters. Additionally, in the second semester students are supposed to have the knowledge about PM concepts, so, the terms will be new for them only from the foreign language perspective.

Basically, the concept implies two ways of organizing learning processes, either having a class with physical presence of participants or organizing an online-based sessions.

It is proposed that the elements of BL approach are better to be allocated on an online-platform, including such components as videopuzzles, audiopuzzles, games, word trainer and dialogues. The key objectives of selecting them were related to increasing students' memory, comprehension, and deeper learning. The main content, where these techniques will be implemented is composed of topics, documents and vocabulary in the field of PM.

A combination of different types of multimedia sources, which were mentioned above, is adopted to superimpose digital contents into student learning environments. In order to assess the knowledge which students get on the platform in a proper way such approaches as online-tests, assignments and games are considered to be effective ways of student's evaluation. [18] state that gamification is able to engage and organize participation. One of its main techniques is based on user's award, hence, it could be implemented to both learning and assessment processes as its influence of points collecting on intrinsic motivation and performance were proved [19]. Besides, such side sources as PM books, journals or news, entertainment elements like songs or some useful links are beneficial bonuses in addition to the general ones. They could serve as an information and learning sources for getting more insights about PM in a foreign language.

Although online-platform can provide multiple functions and elements of BL approach, traditional offline classroom should not be neglected in this case as this technique is being applied in the context of foreign language learning. One of the major reasons for this is live communication during the offline classes. It is known that the importance of speaking skills is enormous for the learners of any language. Therefore, offline meetings are suggested in the format of speaking clubs and consultations. There are various advantages of conversation clubs, but the most important one is that they offer learners a chance to practice a foreign language by actually speaking it. Besides, these clubs are less formal than a classroom setting and make it more fun for the learners.

As it was mentioned before, there will be different ways to evaluate language expertise of learners. In order to provide them support and accompany them on their way of foreign language competence acquisition it is proposed to provide consultations with both foreign language teachers and PM experts.

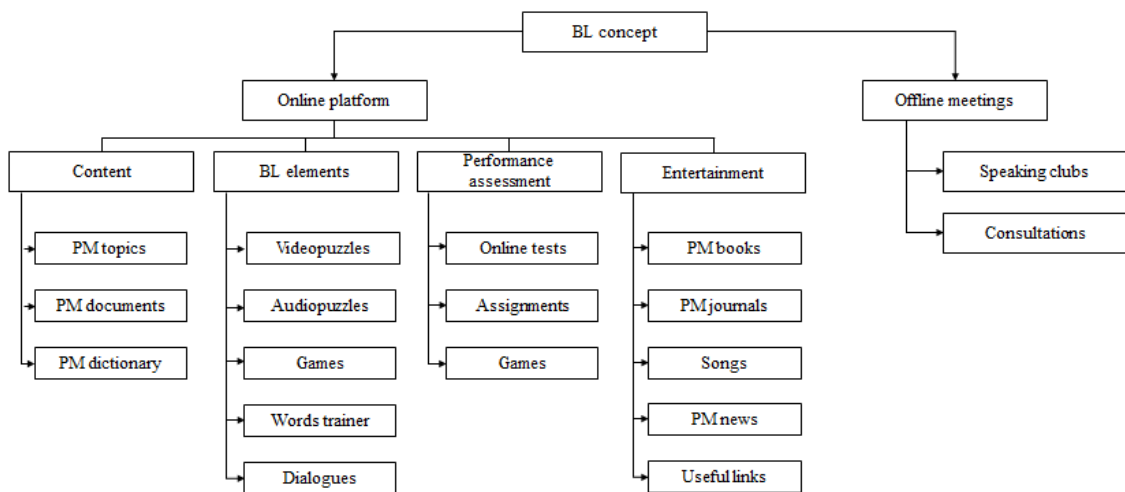The main elements of the BL concept are presented in the Fig. 7.

Figure 7. Representation of the BL concept

In addition to the development of the concept itself, it was also important to consider the sequence of the above listed activities. First of all, the course will start with the introduction to the BL concept, its structure, methodology and grading system. Learning process will include online lessons combined with offline speaking clubs. For the purpose of giving advice and improve performance of the learners. In the middle of the course, after students have some knowledge of the language, a course assignment will be introduced, followed by online lessons, speaking clubs (mandatory and self-organised) and Q&A sessions. The course completion implies presenting the assignment, getting feedback and taking the final test accompanied by the feedback session as well (Fig. 8).
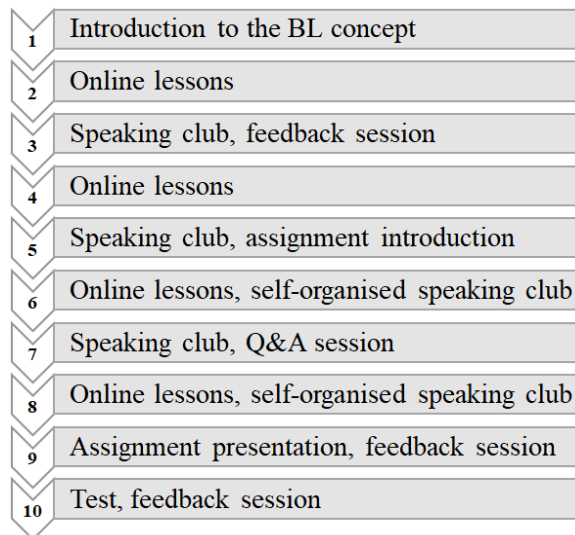

1	Introduction to the BL concept
2	Online lessons
3	Speaking club, feedback session
4	Online lessons
5	Speaking club, assignment introduction
6	Online lessons, self-organised speaking club
7	Speaking club, Q&A session
8	Online lessons, self-organised speaking club
9	Assignment presentation, feedback session
10	Test, feedback session

Figure 8. Learning process timeline

5. Conclusion

In this study the BL concept was introduced to answer the question how the language skills for PM can be developed and expanded in order to increase the level of professionalism of future and present project managers. As working in the PM field means to spend the majority of time communicating with a project sponsor, team members, stakeholders, etc. it becomes obvious how significant is language competence in this context. According to the data obtained from a questionnaire-based survey conducted among EuroMPM students, there is a high necessity and

willing to acquire or improve language skills applied only to PM area. Additionally, the survey provides important information on the positive attitude of the students towards BL approach for learning foreign languages.

This study has provided a description of the BL concept together with the sequence of activities within it. The learning process includes online-platform and offline meetings. The reason for choosing this combination was additionally explained. In order to create a concept that fully meets the requirements and desires of students, data on their learning preferences and recommended BL elements and language learning applications were collected.

As for future implications, this study can be expanded to other PM students out of EuroMPM study program. Moreover, after the implementation of the suggested concept, the level of its efficiency and room for future improvements are to be identified.

6. References

[1] J. Ramazani and G. Jergeas, "Project managers and the journey from good to great: The benefits of investment in project management training and education," *International Journal of Project Management,* vol. 2015, no. 33, pp. 41-52, 2015.

[2] S. Rajkumar, "Art of communication in project management," in *PMI® Research Conference: Defining the Future of Project Management*, Washington, DC, 2010.

[3] K. Muszynska, "Patterns of Communication Management in Project Teams.," *Lecture Notes in Business Information Processing,* vol. 277, pp. 202-221, 2017.

[4] PMI, A guide to the project management body of knowledge (PMBOK® guide), Newtown Square, Pennsylvania: Project Management Institute, Inc., 2013.

[5] M. N. Sibiya, "Effective Communication in Nursing," in *Nursing*, IntechOpen, 2018, pp. 19-35.

[6] I. Varner, "The Theoretical Foundation for Intercultural Business Communication: A Conceptual Model," *The Journal of Business Communication ,* vol. 37, no. January 1, 2000, pp. 39-57, 2000.

[7] L. Matthews and B. Thakkar, "The Impact of Globalization on Cross-Cultural Communication," in *Globalization - Education and Management Agendas*, IntechOpen, 2012, pp. 325-340.

[8] B. Zulch, "Leadership Communication in Project Management," *Procedia - Social and Behavioral Sciences,* vol. 119, pp. 172-181, 2014.

[9] J. K. Henderson, "Language Diversity in International Management Teams," *International Studies of Management & Organization,* vol. 35, no. 1, pp. 66-82, 2005.

[10] D. Bath and J. Bourke, "Getting Started with Blended Learning," Griffith, 2010.

[11] T. Kikot, G. Costa, R. Magalhães and S. Fernandes, "Simulation Games as Tools for Integrative Dynamic Learning: The Case of the Management Course at the University of Algarve," *Procedia Technology,* vol. 9, pp. 11-21, 2013.

[12] M. Sailer, J. Hense, S. K. Mayr and H. Mandl, "How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction," *Computers in Human Behavior,* vol. 69, pp. 371-380, 2017.

[13] Y. Ohkawa, M. Kodama, Y. Konno, X. Zhao and T. Mitsuishi, "A study on UI design of smartphone app for continuous blended language learning," in *2018 5th International Conference on Business and Industrial Research (ICBIR)*, Bangkok, 2018.

[14] J. P. Lousado, C. M. M. Costa, I. P. Oliveira and M. T. G. Roberto, "Audio folios management system for foreign language learning," in *6th Iberian Conference on Information Systems and Technologies (CISTI 2011)*, Chaves, 2011.

[15] G. Paliwoda-Pękosz and J. Stal, "ICT in Supporting Content and Language Integrated Learning: Experience from Poland," *Information Technology for Development,* vol. 21, pp. 1-23, 2015.

[16] P. Taechatanasat, L. Armstrong and P. Nilsook, "Designing a multilanguage blended learning system for Thai agricultural science students," in *2016 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*, Bangkok, 2016.

[17] K. Wright, "Researching Internet-Based Populations: Advantages and Disadvantages of Online Survey Research, Online Questionnaire Authoring Software Packages, and Web Survey Services," *Journal of Computer-Mediated Communication,* vol. 10, no. 3, 2005.

[18] L. Moccozet, C. Tardy, W. Opprecht and M. Léonard, "Gamification-based assessment of group work," in *2013 International Conference on Interactive Collaborative Learning (ICL)*, Kazan, 2013.

[19] E. Mekler, F. Brühlmann, K. Opwis and A. Tuch, "Disassembling gamification: the effects of points and meaning on user motivation and performance," in *CHI '13 Extended Abstracts on Human Factors in Computing Systems*, New York, 2013.

MANAGING DIGITAL TRANSFORMATION IN KAZAKHSTAN: NEW CHALLENGES OF DIGITAL ERA

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Abstract: *New era dictates new rules. Digital era make it clear that enterprises have to change the way they do business on order not to be left behind and keep the balance under new circumstances. Even countries trying to evolve its economy are forced to transform the whole economy branches to digital format. This trend elaborates new challenges and opens perspectives for future development. Managing digital transformation is one of the key issue to be considered. Especially for Kazakhstan. Hence, this study is aimed to reveal the challenges and opportunities of managing digital transformation for Kazakhstan.*

Keywords: digital transformation, project management, information communication technology

1. Introduction

To date, the world has been facing new era – the information era, so called digital. The experts claim that applying digital technologies essentially effects on country economy in the positive aspect: increases the level of labor productivity; ensures labor safety; increases the efficiency of production processes; saves resources; and leads to economic growth. That is why digitalization has become crucial and inevitable for many companies from all over the world, which are striving to adapt their way of doing business under the new circumstances. In addition, project management tools are very important to manage digital transformation. In case those enterprises that do not meet rapidly changing market demands, therefore they are doomed to failure. So new conditions dictate new rules, though it presents new opportunities and challenges at the same time.

Understanding of the highest necessity of digital transformation Kazakhstan accepted this challenge. Since the beginning of 2006 government of the country launched e-government portal in order to provide public services to citizens in digital form. From this moment, government has been continuously working on this direction enhancing and increasing the public services. In addition, many projects were launched such as e-license, tax office, judicial office, state procurements. On top that, the government at the end of 2017 approved the state program "Digital Kazakhstan" which is intended to accelerate the pace of economic development of the republic and improve the quality of life of the population using digital technologies in the medium term [1][2]. Therefore, the goal of our research is to understand and try to reveal what challenges and perspectives gives us managing digital transformation for Kazakhstan.

2. Literature review

There are plenty of academic literature devoted to digital transformation. However, we also consider a number of business literature, company researches and other resources.

First, let us define what actually digital transformation means. Digital transformation – is the process of using digital or information communication technologies to solve various problems in different spheres of economy such as oil & gas industry, medicine, agriculture, logistics, etc. [3][4]. Computer systems and devices, Big Data, cloud services, desktop and mobile applications, analytics, ERP-systems, social media and etc. are the examples of digital technologies. Actually, managing digital transformation is not only about how to use or integrate IT-technologies into all

areas of a business; however, it is also about modifying cultural change, modified education, people's vision, customer experiences, operational processes, business models (see Fig. 1).
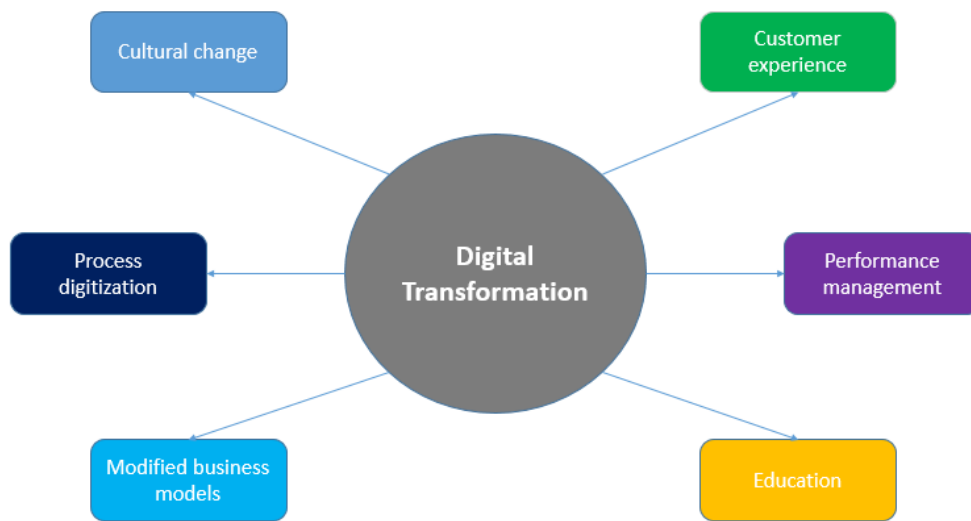

Figure 1. Digital transformation components

On top that, we need to differentiate two more definitions: *digitization* and *digitalization*. Digitization means the process of information conversion from analog to digital. Earlier physical or typed documents was the main resource for keeping data. However, with the use of computers digital files became convenient and easier, so that business started convert paper records to digital format. Digitalization means the process of using digitized information in order to simplify the way of doing business and make it more efficient. [4]

Digital transformation is essential for companies. Evidence of that claim can be found in research based on the narratives from American Financial institutions adopting digital technologies. [5]

Cloud services and resource virtualization – are considered to be more technical aspect of digital transformation of enterprises. These two vital drivers can enhance effectiveness, speed and mitigate risks of data failure. [6]

One of important thing in digital transformation is how to manage it. Project management plays vital role in digital transformation. Mark A Langley, president and CEO from Project Management Institute, states that enterprises applying effective portfolio, program and project management processes in its organizational strategies are most likely doomed to success in their digital transformation strategies. [7-9]

Researchers from Massachusetts Institute of Technology highlighted three vital pillars in digital transformation of enterprises. They are customer experience, operational processes and business models. All these pillars decompose into nine elements. [10]

In Kazakhstan, on state level, the process of digital transformation is being well. For instance, nowadays egov.kz portal provides 190 million different services, and about 7 million users are registered on this portal. More than 740 services have been translated into electronic form. In addition, we have mobile application of the portal with 3.3 million users with 10 million services, more than 80 services are transformed into digital form. Besides, there is state "Digital Kazakhstan" program approved by government in 2017 and aimed to improve the economy, people's life, and enhance competitiveness of our country. Implementation period of program is 2018-2022 and it will be carried out in five directions:
1. Digitization of the economy branches,
2. Transition to the digital state,
3. Implementation of the digital Silk Way,

4. Evolution of the human capital assets,
5. Innovative ecosystem formation [1] [2].

However, there are available some gaps in this program: program does not take into account people's opinions, thoughts, and psychological preparation regarding digital transformation. Therefore, we need to answer to some questions: how well people prepared for the digital transformation, is this necessary for them, what people should like to learn during the process of digital transformation, and other issues.

3. Research design

As we stated before, the main goal of this study is to reveal the challenges and opportunities of digital transformation for Kazakhstan. In order to achieve this, we identified three stages:
1. Conduct survey and interview to get quantitative and qualitative data.
2. Analyze obtained data.
3. Summing up the results.

So that we took part in Erasmus+ Capacity-building in Higher Education project "ManDiT: Managing the Digital Transformation", and we took list of questions from this project. Target groups such as students, lecturers, higher education institution (hereinafter, HEI) management, companies and professional associations divide the questions. Most questions of each target groups are almost the same in the meaning, so that it gives a good basis for analysis. Answers are designed according to "Likert scale" 1-5 approach, where 1 = "strongly agree" and 5 = "strongly disagree". The questionnaire was anonymous, however we decided to include some information like gender, age, education (specialty), job area, and position respectively by target groups. This was done for additional analysis. Then we sent questionnaire to undergraduate and postgraduate (Master and PhD) students, academics (young lecturers, professors) from International IT University and its management, too. Moreover, we also sent the questionnaire to practitioners (project managers, developers, specialists, analysts, etc.) from the companies and professional associations and we took interview from them. Interview is also based on project's questions. There were considered small and medium enterprises, as well as large organizations. The Project Management associations were examined as professional associations. Hence, in general we received 200 responses from all target groups.

Regarding the technical aspect of questionnaire, we developed it based on the Google Forms – one of the most popular service provided by well-known Google Company. This is great, effective, easy to use, and responsive service. [11]

4. Results and Conclusion

As we mentioned before, the study is based on the survey and interview results. Now let us draw your attention to obtained data analysis, and statistics.

First, the questionnaire revealed that more than 95% HEI staff agree that digital transformation is vital topic in the university. We guess, that the reason is obvious, the popular and necessary topic. The most part of students, lecturers, companies consider that they are well prepared for digital transformation; however, almost half of respondents from associations claim that they are not.

Next interesting fact gives us Fig. 2, which is about the necessity to better descriptions the required competence profiles for the digital transformation. The question concerned several target groups. In short, the question is about clear understanding of necessary competencies for the digital transformation. Majority of students, industry representatives, and associations acknowledge this fact, albeit almost 50% of lecturers are not sure about this issue and of neutral opinion. This means that respondents do not clearly understand those competencies. Besides, it confronts to the answers of respondents to the question regarding preparation for digital transformation. We assume, that experts of the state program "Digital Kazakhstan" did not take it into consideration, and explanatory work is not as effective and clear as it has to be.
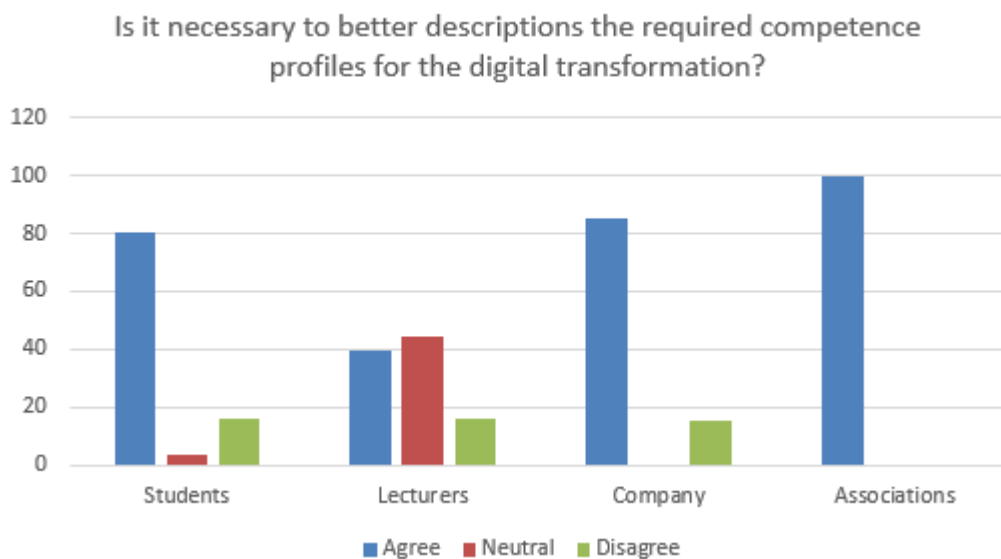
Figure 2. Competence profiles for digital transformation

The following questions are common in their meaning:
1) Do you see the need for a study topic "management of the digital transformation"?
2) Do you see the topic "management of the digital transformation" as relevant for you?

The point of these questions is necessity of studying topic "management of the digital transformation". As you can see in Fig. 3, the most bulks of respondents of each target group confirmed the relevance to study this topic. This fact also shows the weakness of state program "Digital Kazakhstan" on the direction of "Innovative ecosystem formation", and probably in direction "Evolution of the human capital assets", too.
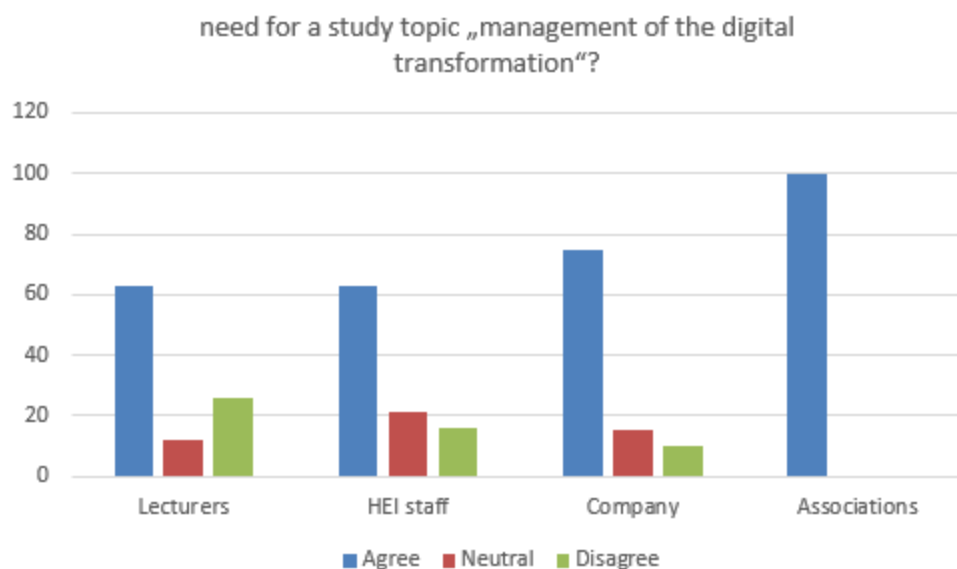

Figure 3. Demand on a study topic "management of the digital transformation"

To sum up, according to our research results we revealed that there are available some gaps in the "Digital Kazakhstan" program. Program does not work as well as expected. Some issues in its directions should be revised.

5. References

[1] State program "Digital Kazakhstan": https://digitalkz.kz/en/trends-of-the-program/

[2] E-government portal web site: https://egov.kz/cms/en

[3] Digital transformation definition, From Wikipedia: https://en.wikipedia.org/wiki/Digital transformation

[4] Digitization, digitalization, and digital transformation definitions and differences: https://www.salesforce.com/products/platform/what-is-digital-transformation/

[5] Essence of digital transformation – Manifestations at large financial institutions from North America, Pramanik H.S., Kirtania M., Pani A.K. "Future Generation Computer Systems", Volume 95, June 2019, pp. 323-343

[6] Digital transformation of manufacturing through cloud services and resource virtualization, Borangiu T., Trentesaux D., Thomas A., Leitão P., Barata J. Computers in Industry, Volume 108, June 2019, pp. 150-162

[7] How to make the most of project management in the digital age: https://www.europeanceo.com/business-and-management/how-to-make-the-most-of-project-management-in-the-digital-age/. Author: Mark A Langley, President and CEO, Project Management Institute

[8] Project Management Institute: https://www.pmi.org

[9] Project Management Body of Knowledge Guide (PMBOK® MANUAL), Sixth edition.

[10] The Nine Elements of Digital Transformation: https://sloanreview.mit.edu/article/the-nine-elements-of-digital-transformation/. Authors: George Westerman, Didier Bonnet, and Andrew McAfee

[11] Google Form service: https://www.google.com/intl/en/forms/about/

COMPETENCES MANAGEMENT FOR THE DIGITAL TRANSFORMATION: FRAMEWORK TO ADAPT THE USABILITY OF THE ASSESSMENT TOOL

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Abstract: *Digital transformation and its values are frequently discussed in the society. Nevertheless, small and medium-sized enterprises (SMEs) experience certain lack of resources to go digital by their own. Thanks to the government programs, German SMEs can get external support in frames of management consulting, in our case – digital transformation management consulting. Current paper considers a case of the competence assessment tool developed and owned by one of the German consulting companies, which helps to overcome challenges of digital transformation via competences management. Based on a case study and literature research, the framework will be proposed on how the competence assessment tool can be improved and further maintained.*

Keywords: competences management, digital transformation, management consulting, competence assessment

1. Introduction

Concepts of digital transformation tend to bring high value both to society and economy. As mentioned by several scholars researching in this field there is no general definition of digital transformation. Nevertheless, digital transformation should be carefully managed paying attention to its various aspects.

[1] uncover the subject of digital transformation from project management domain. Digital transformation can be seen as a project, which demands not only certain competences to drive it, but requires a comprehensive approach in the frames of competence model for the digital transformation. The need for the model is determined by the complexity of the project as well as uncertainty related with future transformation projects.

Also, this kind of project can be considered from the change management perspective. As addressed by [2], the transformation term, considered from change management perspective, is applied to describe "the extent of strategic change" since the organization during transformation process changes, overall, "its paradigms of doing things" [2, p. 541].

Besides, the term of "Industry 4.0" is in a focus of a big number of researchers, entrepreneurs and companies, who are interested in creating the impact and become a competitor in a fast-changing environment. Industry 4.0 is considered in the literature not only as the fourth step of industrial revolution, but also as a target, sustainable state, which is supposed to be reached with the digital transformation processes.

[3] stress out a big difference between SMEs and large companies and uncover the factors preventing these enterprises to implement any changes related with the quality improvement in the company. Among the most important factors influencing those initiatives are lack of top management and employees' commitment, high costs and workload.

[2] talk precisely about the issues which SMEs face when implementing the digital transformation and the most challenging is the need "to develop digital capabilities and implement them into fast-changing, cross-company processes and structures" [2, p. 540]. The reasons behind this challenge the authors see in the lack of resources to drive the transformation projects: both in personnel and financial resources fields. The employees of SMEs are involved in their daily

activities and experience lack of additional competences to manage transformation. The budget of SMEs is limited to perform the transformation activities with the help of external services. [2] SMEs in any country face the lack of resources. For example, while discussing the case from the UK, the authors underline that lack of finance, knowledge and skills prevent the SMEs from going digital. [4]

The need for skills to take the specific actions for the transformation by German SMEs is also underlined by [5]. The challenges faced by SMEs which are stressed out by the authors are "security, data protection, and loss of control over their own data, costs, time, or the high implementation effort as reasons for slowing things down" [5]

Although, SMEs experience lack of resources to drive digital transformation projects by their own, the German government entities see SMEs as economy drivers, and, hence, are ready to support them with various sponsoring opportunities [6]. That brings a synergy effect to both sides of SMEs and Government, since SMEs, transformed digitally, will be able to add more value to German economy and society.

Hence, thanks to the investment strategies of German government, SME's can afford themselves to be externally supported by the management consulting entities.

2. Case description

Management consulting organizations represent the entities, who guide its clients from business and not-for-profit domains, mostly externally, in their management activities. The goal of consultants is to provide a professional support to the customer in achieving a certain success and moving business or non-profit organization forward. [7]

The consulting company considered in this paper is usually being selected by German ministries to run the projects on the strategic human resources management and organizational development in German SMEs. The reasons behind is more than 20-years of experience in the field of managing strategically important projects as well as a strong network of Government entities, IT companies, and other consulting organizations.

Today, the consulting company is constantly applying its rich experience in organizational development and proceeds to help the companies from different economic spheres to overcome new challenges. Talking about the near future, the company sees the consulting trends in a process-oriented business environment. In the field of strategic human resources management that will lead to more structured approaches to solve personnel issues. With attention to the competence management, the today's and future challenges are seen by the company in generation issues and resistance to implement the changes, especially within digitalization stage. A current approach of consulting SMEs in digital transformation topics can be performed with the following graph (Fig. 1).
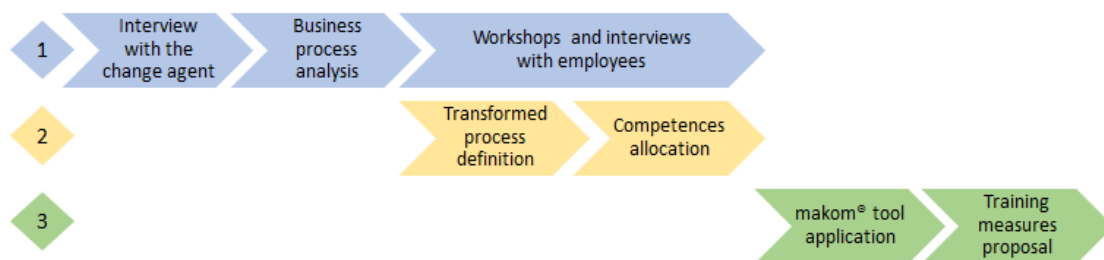

Figure 1. Process of consulting SME's in digital transformation (author)

Consulting process of the company can be described by seven steps in three stages. On the first stage, the company interviews a SME's representative assigned to perform transformation activities. Next, the SME's process flowcharts and business specific or, if applicable, business models are analysed. In this step, based on the interview results and business processes analysis, the consulting company creates possible strategies for the transformation.

Further, the series of workshops are scheduled and then conducted by consultants. During these workshops, the developed by company model to assess the maturity level of SMEs regarding the digital transformation is applied. Then employees are asked how they see the process "now" and "in future", so the redesign of processes is conducted together with employees. After, the competences needed to perform these processes (both for "now" and "in future") are allocated to every process.

On the third stage the application of web-based tool takes place. All information gathered on previous steps is being put into the tool for further assessment, when employees evaluate themselves and considering these results, the next final step takes place for training measures and process improvement proposals.

2.1 A web-based assessment tool

The consulting company has been working with competences assessment in German SMEs since June 2012. At that time the consulting company was involved in the big project with the aim to create a competence profile of the organization evaluation the employees from various departments of construction, purchasing, mechanical engineering, delivery, etc. Competence assessment was difficult to manage because of the big amount of data (ca. 80 different competences distributed in several files for analysis) and MS Excel sheets were not that helpful in this case. To solve this usability issues the company started to develop a web-based assessment tool in 2014.

The tool makom® is based on the established in 2012 framework and contains an explicit database enabled by the web-platform [8]. In the end of 2014, the pilot version was tested, and in April 2015 the tool was officially presented in Dortmund. In general, the focus was on how to structure competences and align human resources and strategy of the organization, what didn't present a big interest for the customer and hence the improvements were required.

For this reason, the makom® tool was essentially improved during 2015-2017 and, in its turn, that led to the win in the nomination "The best IT-solution-2017". The reason behind is that the makom® tool is not only an IT-solution, but it is a tool which provides a good business solution and can maintain strategic human resources management of the company.

As described in the Fig. 1, the makom® tool application takes place in the third stage after the competences for the present and future processes were already allocated. After the competences are described and put into the tool, to every element of it the employee, who is supposed to possess this competence, is allocated for further evaluation. Besides the ID, the tool also contains the age of the employee to make then an age analysis and comprehensive resource planning.

The competences are grouped into the category named after processes or departments. Every category has a subcategory with the competences and its description, derived from the workshops (second stage of the Fig. 1). Those categories of competences and its description create a competence profile of the department or the consulted organization in general.

The tool has four levels for competences evaluation: no knowledge, basic knowledge, advanced knowledge and expert knowledge. There is no required level for every competence is determined but defined the number of people (in percentage) who should be on the one of four levels.

During the evaluation, employees can assess themselves on which level of competence they feel themselves, or this assessment can be also done by the supervisor, so-called, external assessment. Both results can be then compared and present a holistic assessment matrix. Besides the assessment, the employees are also being asked if they want to be trained in future to enhance the competence level.

As the result of the evaluation, the makom® tool reflects the competence profile of the organization, and thanks to the information regarding the age of employees, in case of the close retirement of "experts", the organization can already plan to enhance the number of new employees to feel the future gaps.

On the last step, the tool proposes several training measures if the employee is required this education and agreed to be trained (it is an additional question in the assessment procedure).

Eventually, the core idea of the tool is to reflect the competence profile of the organization, so the company then can know by whom they can replace the employee, if he is ill or cannot perform the work anymore. In addition, the aim of the tool was to maintain resource planning. And with the need of the organization to transform digitally the tool can also perform the gaps assessment between the competences needed to perform the present processes and the competences required to perform the work related to the newly designed and digitally transformed processes. That sufficiently expands the scope of the tool and significance of it for the digital transformation management.

2.2 makom ® case discussion

A self-assessment provided by the makom® tool leaves some open questions behind. It is not clear how people evaluate themselves and what factors are influencing this evaluation. As well as there can be possible limitations caused by the self-confidence level of the employee and the trust between the employee and evaluation tool, or the supervisor and the employee in case of external assessment. That uncovers the need to research about limitations when performing in so-called competence testing centre.

Further research of the competence management can evolve into the framework of competence management for the digital transformation (CMDT) model [1]. To build this model we need to gather more competence elements and, hence, more indicators are required. The makom® tool in the current state enables only analysis of four levels of competence, ID of the employee, their age and, if applicable, the department or process related to the competence. With the development of the additional testing measures, for example, in the frames of multiple-choice questions, there will be more opportunities to gather required for the model indicators. These testing measures would address certain products and certain knowledge to be possessed by the employees, but also the new testing measures will require smart approaches and the new digital techniques for data acquisition or other business intelligence tools.

3. Theoretical Background

The aim of the literature research is to answer the next questions:
- what is the digital transformation,
- is there any framework of competences categorization for digital transformation,
- which competence assessment modes do exist,
- what are the parameters of tests,
- how to prove the reliability and validity of the testing measures.

3.1 Digital transformation

The term of digital transformation has different perspectives and, hence, different definitions, what is not surprisingly, since the term itself is quite new for the scientific and research world. Most of the definitions contain the focus on value creation and change in the business model to shift a competitive level of the organization. A speed of this change is dependent on the art of transformation: if the organization is forced to be changed or does it voluntarily [2].

Also, in the most of literature sources the term or digital transformation is identified with the term of Industry 4.0. But it is more advisable to distinguish between these two terms and consider the term of Industry 4.0 as the target state which can be reached by the digital transformation process, as it was underlined by [2].

Besides discussion about the competences needed for Industry 4.0, professor Abel [9] provides first a list of technologies / technologic fields related to the Industry 4.0, which are associated with: sensors, actuators, big data, cloud computing, data security, communication, human machine interface, software standards and standardization, shift adjustment via Web 2.0, mobile

devices, tracking by the customer or the customer, robotics, additive method, wearables, augmentation technologies.

3.2 Competences for the digital transformation

Over the years the definition of competence has got different perceptions and interpretations. Based on analysis of competence definitions, [10] provide the readers with a comprehensive discussion comparing the term of "competence" with the terms of "performance", "qualification", "capability and ability", "knowledge, skills, and attitudes", "expertise".

[11] present an alternative concept of competence for vocational education and follows the next view on the competence as: "vehicle for the creation of selfhood and of forming and transforming the world" (Kovacs, cited in [11]). This broad view reflects a high complexity of the competence's concept.

German scholars [12] point out that before evaluation the competences should be organized in reasonable categories, which are recommended to be derived from specific job profiles and actual requirements, as well as an assessment itself must be possible to be adjusted for future job requirements.

One of the researchers who covered recently the topic of future competences development for digital transformation distinguishes between qualification ("knowledge and skills necessary to perform a particular activity") and competence ("a learnable ability of an employee to perform certain tasks independently"). To define Industry 4.0, author chose to describe it as "real-time capable, intelligent, horizontal and vertical networking of people, machines, objects and ICT systems for the dynamic management of complex systems" (Bauer et al., 2014, p. 18 cited in [9]). Based on a systematic literature review and business case studies, the author discusses possible scenarios of Industry 4.0 and allocates future professional qualifications requirements to relevant roles in the SME. His findings grab attention since he distinguishes which role in the company will require definite skills to drive digitalization, which include IT skills and abilities to communicate in English for every role. [9]

Since industry shifts its level, the same with competences: people will need more professional and interdisciplinary competences, which are separated in different levels and professional areas, and classified into three areas: social competence, self-competence, professional and methodical competence [9].

All in all, this research gives a good impression on the topic of competences for the Industry 4.0 in German SME's and other current challenges the companies face regarding digitalization.

[12] when introducing competence management tool for SMEs which addresses current and future competences, also discuss the ways to evaluate the gaps in competence profiles, but before they also talk about competences domains and types, touching the topic of digitalization challenges in German SME's.

Another paper describes a developed software tool for competences evaluation. In this tool the next five categories of competencies present: managerial, specialized technical and professional, basic operational, scientific and academic, and personal effectiveness competencies [13].

[14] describe a web-based tool to assess competencies involves only three groups of competencies: professional, innovative and social, which then are separated in twelve subcategories, forming sixty-three categories elements in total.

Among the reviewed literature sources towards competences for digital transformation, the "DigComp 2.0: The Digital Competence Framework for Citizens" [15] is worth mentioning. This reference model developed by European Commission considers five areas of digital competences: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. These competence areas present so-called "dimension 1", a part of digital competence, whereas "dimension 2" supports every area with relevant competence descriptor.

Table II summarizes categories which the authors used in their research papers.

As can be seen, authors used different approaches of definition and categorization of competences ("x" means the same title of competence category, starting with "*" – partially the same), hence comparing them can be complicated.

Table I. Summary of competence groups from relevant literature source

Categories / Authors	Abel, 2018 [9]	Decius & Schaper, 2017 [18]	Bohlouli et al, 2013 [19]	Mittas et al, 2015 [20]
methodical	x	x		
professional	x	x	* specialized technical and professional	x
social	x	* interpersonal		x
self-competence / personal	x		* personal effectiveness	
knowledge based		x	* basic operational	
communicational		x		
managerial			x	* part of professional competence
scientific and academic			x	
innovative				x

The gaps in this comparison can be seen in the different focuses of competence categorization. E.g., [9] has proposed the categorization exactly for the framework of digital transformation, whereas other scholars focused on SMEs and competences in general.

3.3 Modes of competences assessment

As it claimed by scholars from Switzerland, the competences assessment is needed to prove that "the persons possess the necessary competencies to perform assigned functions to an acceptable level" [16]. [17] underlines the importance of assessments which have been proven the increase in productivity, cost savings and other business outcomes. Among assessment methods author distinguishes between knowledge, skills and abilities-based assessments and task-based assessments. Among first group are:
- cognitive ability tests to assess job performance related to verbal, mathematical, reasoning, reading abilities and involve multiple-choice items as a testing measure [17, p. 6];
- job knowledge tests to measure, in general, technical knowledge and skills to perform a daily work [17, p. 7].
Heukelman [18] among measuring skills' methodologies underlines that assessment and testing are suitable to assess cognitive skills, but limited in their applicability, as, for instance, performance-based testing measures are time consuming and deal with bigger amount of skills.
Another limitation besides resources consuming performance-based assessment is the performance itself influenced by external factors within the competence centres.
[19] underline that the performance and competence are correlated but should be measured in the different settings. What is important, that the scholars point out that these parameters could be correlated when the external circumstances will be the same (in the cases discussed these conditions were consultation time and efficiency of the doctor). These circumstances cannot be neglected since they were also a part of assessment. [19]
Abstracting from external factors which influence the performance-based competence evaluation and focusing further on self-assessment and external testing, the scholars underlined that self-evaluation is treated less threatening than the one done by third parties. It is seen as an

autonomous, requiring less resources measure, and also helping the learner to grow and develop him-/herself continuously [20].

There is the next definition of self-assessment provided: "the evaluation or judgement of 'the worth' of one's strengths and weaknesses with a view to improving one's learning outcomes" (Klenowski, 1995, p. 146, cited in [21]). The scholar underlines the doubts about self-assessment techniques since the test takers can under- or over-estimate their abilities since the criteria of good performance can be perceived differently [21].

Multiple-choice tests present an assessment measure having true / false and one-best-answer items. Both have pros in cons, e.g., when choosing among true / false items, it is not clear which one is absolutely correct. Also, there is a need to create a pool of items to prevent test takers from exchanging right answers. [22]

Nevertheless, multiple-choice measures were claimed as the most commonly used type of assessment, but also limited: if the test taker guessed the answer or had the certain understanding of the subject. In general, the main benefit of this assessment is that it can be graded quickly having an answer key regardless the testing was performed in analogue or digital way [23].

Among several possibilities to measure competence, multiple-choice tests are claimed as "an efficient and objective way to assess knowledge" [16]. The authors underline, that development of this kind of tests requires an expertise in test creation itself, where question stem, varying number of correct and wrong answers (distractors) should be considered.

3.4 Testing measures' parameters

[22] lists the next properties of multiple-choice tests:
- difficulty, extend, to which a test taker can or cannot answer the question,
- differentiation ability, relation between those who answered the question due to knowledge or randomly guessed an answer,
- validity and reliability, which are not addressed by the author and considered further. However, the last two parameters are related to any kind of testing measures, including self-assessment.

Validity is claimed as the most important factor to ensure accuracy of the testing measure, which can be determined in empirical way involving data collection and formula application, or inspection, intuition and common sense [24].

Furthermore, the scholars from UK provide us with the definition of a valid self-assessment: "'judging one's performance against appropriate criteria'', and accurate self-assessment: ''gaining reasonable concurrence between self-claimed and other, validated measures of performance'' (Gordon, 1991, cited in [25]).

American scholar Pulakos [17, p. 16] defines validity as "the extent to which the assessment method is useful for predicting subsequent job performance" and considers it as one of the key criteria for evaluation of assessment methods.

Basic testing property is reliability, - "the consistency of the scores produced by a measurement tool" [21]. As well as [16] treat reliability as an indicator of consistency (measurement of the same competency) and repeatability (near the same test results produced with time intervals) of the test. This indicator can be proved, e.g., by test-retest, split-half application (for test items with more than one right answer), or internal consistency, which can be measured by Cronbach's alpha and the Kuder-Richardson equation. As a rule of thumb concerning reliability, authors recommend taking rkk ≤ 0.85.

3.5 Correlation between test's results

Since the considered assessment tool has already produced results from competences evaluation and the new tests will determine new data production there is a need to understand the ways to describe relations between the assessment outcomes.

[26] define correlation as "the degree of association between two variables, whereas regression expresses the form of the relationship between specified values of variable and the means of all

corresponding values of the second variable", and it is used to measure similarity between objects, or multidimensional variables.

The covariance is used to measure correlation between two sets of variables, in sense if covariance is positive or negative, the relation between variables will be linear or nonlinear respectively. When two sets of variables are independent, the covariance will be zero and that means, that those sets are independent [26].

One of the basic tools to perform this relationship graphically, correlation charts or scatter diagrams can be used. It is claimed by [26] that scatterplots are more informative than just correlation coefficient analysis, while it provides a visual summary of relations between data sets.

4. Results and discussion

4.1 General improvement of consulting approach

An analysis of consulting approach revealed certain gaps in the allocation of competences during the workshops. To fill this gap, the participants of the workshops need to have a pre-round of training activities to learn their processes in order to be able to do a comprehensive analysis of the "as-is" process and a proper design of the "to-be" process.

So, this process acknowledgement procedure can be performed with the help of a web-platform and make a first impression on what employees will be working on during upcoming workshops, as well as it can create a buy-in effect since the test takers will already think about the processes and white spots for transforming them digitally.

The makom® case study analysis leads to the conclusion that there is a need for finding a framework to categorize competences for future implementation in practice. As was underlined above, scholars categorize competences in different manner. For developing the testing measures, we need to have a pool of questions structured and grouped in the way to use and reuse them permanently. Based on literature review it can be summarized that professional competence will vary from company to company case.

The next competences categorization framework can be proposed:
- professional competences category, including basic operational, specialized technical and knowledge-based competence,
- social competences category, involving personal and interpersonal competences;
- digital competence category, covering elements of methodical, managerial and innovative competences.

Managerial competence as part of digital category means the skills to perform project management activities regarding digital transformation project.

4.2 Tests creation

Currently, to evaluate their competences, the employees and/or their supervisors are being asked to assess the level of the skills possessed via self-assessment questionnaire, but no external testing measures are performed to make this evaluation more reliable.

What is important, that the consulting activities are conducted with employees who will then work within new business processes and can uncover all specific features of their daily work. They create a valuable effort to improve the processes by describing the new processes ("to-be" process) and with the help of the consulting company they will require to perform them.

In the literature research part several factors of assessment tool creation were mentioned. Both multiple-choice tests and self-evaluation questionnaire have their advantages. Nevertheless, having two options of competence assessment can bring additional value to consulting approach. Since the consulting company already has its assessment tool with self-evaluation questionnaire, there is a need to consider an existing scale to link with the new one of multiple-choice test.

As mentioned before, current makom® tool evaluates the next types of professional skills rating: no – basic – advanced – expert knowledge.

To build the testing measures into current "makom" model, these levels should be transferred to the per cents (Table II).

Table II. The scales binding

Level	Points' interval, %
no knowledge…little knowledge	0 ... 30
basic knowledge	31 ... 69
advanced knowledge	70 ... 85
expert knowledge	86 ... 100

The core idea of multiple-choice questions creation is that new testing measures will perform at least 10 questions related to the competence – in today's mode and for future, which is considered the most valuable to be tested (applicable to several processes).

The total amount of questions is to be transferred to 100% scale. All in all, the measures need to be adjusted to every competence being tested and to be specified for every company case.

4.3 Testing measures' system maintenance

Every case by every consulted company will require adjustment for testing professional competences, since they are very specific. Therefore, while creating multiple-choice questions the test should be flexible and adjustable for quick changes. To help with the speed of adjustments concerning how to randomize the questions, special software tools can be called in.

Another important point that the database of the competences gathered by the consulting company since 2014 is rather big and the competences can be grouped by every industry, then it can be analysed to find similarities and further a new database with the multiple-choice questions needs to be developed. This process can be described with the chart presented in the Fig. 2.
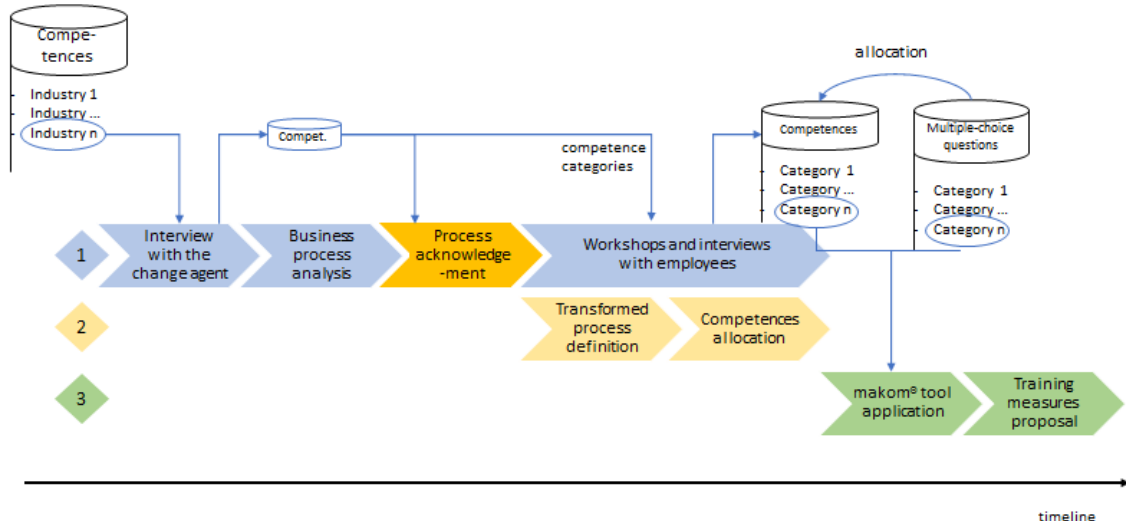

Figure 2. The process of the competences' database maintenance

The main purpose of the database maintenance is not to extend a timeline of the consulting process. The work related to the creation of the multiple-choice questions can be done in parallel to the traditional for the company approach.

When the company which needs to be consulted is defined, the industry of it is already clear. Further, during the first interview an idea appears about which competences are in place.

As mentioned above, every case will require its own set of multiple-choice questions to test the competences. The most challenging will be to form the questions regarding technical product competence testing (professional category) since it depends on the information or product systems possessed by the considered company.

The core idea to overcome this challenge will be the next approach:
1. Analyzing the manual of the software / hardware application
2. Consulting with the with the responsible employee / supervisor involved into the consulting activities to understand the main points to be tested into multiple-choice test
3. Creating the questions concerning the usability / special features which are crucial to perform the job with this software / hardware product.

As it was mentioned by [17], tailored assessment tools require more effort regarding creation of evaluation techniques but at the same time that will bring more value to every business case: employees will see that they are tested in relevant to their job abilities and hence it can minimize a resistance from their side. That is why these measures of adjustment and tailoring are worth implementing.

To improve the quality of testing measures' system "plan-do-check-act" cycle can be applied after testing pilot version and afterwards in general:
- creating multiple-choice questions for every case,
- testing the measures on the company and gathering feedback,
- retesting if needed and working on quality issues from content or software perspective,
- implementing the changes when creating new measures and approve them in practice.

Talking about quality issues, the selection of appropriate platform for testing measures performance requires a careful analysis from usability and technical side in general. The platform should be designed with user-friendly interface and have possibilities to adjust the test items in efficient way.

5. Conclusion

Digital transformation projects add value to the companies but require special competences to manage them.

The makom® case description uncovered several gaps in lack of theoretical background to group competences in certain categories. Besides, the results of the literature research are recommended to be considered to create an own "umbrella" term of digital transformation, which will be appropriate for the customers.

Since the consulting company already has its own self-assessment tool, literature research attempted to answer the question what advantages and disadvantages self-evaluation and multiple-choice tests have, and on which factors we need to pay attention when developing new assessment approaches.

Another focus of literature research was to review competences categorization in relevant sources related to competences assessment tools. Here we can see some gaps since special group of competences were not considered: what exact managerial competences should be involved when performing transformational activities and what their role in the organization. Therefore, project management standards should be reviewed carefully and especially Organizational Competence Baseline from IPMA ® [27]. Afterwards, it is highly recommended to combine theoretical and practical approaches to competence categorization to structure further the competence management approaches.

Several technical parameters of multiple-choice tests were considered, hence, there is a need to involve more research activities to find relevant statistical tools to evaluate reliability and validity of test items.

As it was mentioned in literature review, the design of an assessment tool requires competence in developing evaluation techniques itself and experts' interviews can positively influence the design process.

After all, it can be concluded that the new assessment measures in frames of multiple-choice tests can be performed and aligned with the current competence assessment tool.

6. References

[1] Wolff, C., Mikhieieeva, O., Nuseibah. A., "Competences and the Digital Transformation," in *Project Management and Engineering Research: AEIPRO 2018, Ayuso Muñoz et al., Lecture Notes in Management and Industrial Engineering*, Springer, 2018.

[2] Goerzig, D., Bauernhansl, Th., "Enterprise architectures for the digital transformation in small and medium-sized enterprises," in *11th CIRP Conference on Intelligent Computation in Manufacturing Engineering - CIRP ICME '17*, 2018.

[3] L. Mendes and L. Lourenço, "Factors that hinder quality improvement programs' implementation in," *Journal of Small Business and Enterprise Development,* vol. 21, no. 4, pp. 690-715, 2014.

[4] I. Stankovska, S. Josimovski and C. Edwards, "Digital channels diminish SME barriers: the case of the UK," *Economic Research-Ekonomska Istraživanja,* vol. 29, no. 1, pp. 217-232, 2016.

[5] S. Wiesner, P. Gaiardelli, N. Gritti and G. Oberti, "Maturity Models for Digitalization in Manufacturing - Applicability for SMEs," in *Moon I., Lee G., Park J., Kiritsis D., von Cieminski G. (eds) Advances in Production Management Systems. Smart Manufacturing for Industry 4.0. APMS 2018. IFIP Advances in Information and Communication Technology, vol 536*, Cham, Springer, 2018, pp. 81-88.

[6] KfW-Group, "KfW SME Panel," KfW Group, October 2018. [Online]. Available: https://www.kfw.de/KfW-Group/KfW-Research/Publikationen-thematisch/Mittelstand/. [Accessed 20 December 2018].

[7] B. Curnow and J. Reuvid, International guide to management consultancy., 2 ed., London: Kogan Page Limited, 2003.

[8] mpool consulting Gmbh, ""Ihr Unternehmen auf einen Klick" - das Kompetenzmanagementsystem für den Mittelstand," mpool consulting Gmbh, 2018. [Online]. Available: http://www.makom-mpool-group.de/. [Accessed 16 December 2018].

[9] J. Abel, "Kompetenzentwicklungsbedarf für die digitalisierte Arbeitswelt," FGW – Forschungsinstitut für gesellschaftliche Weiterentwicklung e.V., Düsseldorf, 2018.

[10] A. Stoof, R. Martens, J. van Merriënboer and T. J. Bastiaens, "The Boundary Approach of Competence: A Constructivist Aid for Understanding and Using the Concept of Competence," *Human Resource Development Review,* vol. 1, no. 3, pp. 345-365, 2002.

[11] C. Velde, "An alternative conception of competence: implications for vocational education," *Journal of Vocational Education and Training,* vol. 51, no. 3, pp. 437-447, 1999.

[12] Decius, J., Schaper, N., "The Competence Management Tool (CMT) – A new instrument to manage competences in small and medium-sized manufacturing enterprises," in *7th Conference on Learning Factories, CLF 2017*, 2017.

[13] M. Bohlouli, F. Ansari, Y. Patel, M. Fathi, M. Cid and A. L., "Towards Analytical Evaluation of Professional Competences in Human Resource Management," Vienna, 2013.

[14] N. Mittas, G. Kakarontzas, M. Bohlouli, L. Angelis, I. Stamelos and M. Fathi, "ComProFITS: A Web-based Platform for Human Resources Competence Assessment," Athens, 2015.

[15] R. Vuorikari, Y. Punie, S. Carretero and L. den Brande, "DigComp 2.0: The Digital Competence Framework for Citizens.," 2016. [Online]. Available: http://publications.jrc.ec.europa.eu/repository/. [Accessed 28 January 2019].

[16] D. Hardmeier, C. Müller and A. Schwaninger, "Certification of airport security officers using multiple-choice tests: A pilot study," Rome, 2014.

[17] E. Pulakos, Selection Assessment Methods. A guide to implementing formal assessments to build a high-quality workforce, USA: SHRM Foundation, 2005.

[18] D. Heukelman, "Measuring e-readiness: A case study: Self-assessment vs performance testing," Mauritius, 2017.

[19] J. Rethans, F. Sturmans, R. Drop, C. van der Vleuten and P. Hobus, "Does competence of general practitioners predict their performance? Comparison between examination setting and actual practice," *BMJ,* vol. 303, pp. 1377-1380, 1991.

[20] K. Tirri and P. Nokelainen, Measuring Multiple Intelligences and Moral Sensitivities in Education, Rotterdam: Sense Publishers, 2011.

[21] J. Ross, "The Reliability, Validity, and Utility of Self-Assessment," *Practical Assessment, Research & Evaluation,* vol. 11, no. 10, 2006.

[22] A. Sayapin, "Multiple Choice Assessments: Evaluation of Quality," Berlin, 2013.

[23] S. Cunningham-Nelson, A. Goncher and W. Boles, "Categorising Student Responses for Feedback Based on Multiple Choice and Text Responses," Wollongong, NSW, Australia, 2018.

[24] C. Li, "The Criterion-related Validation of TEM4 Based on Test-takers' Self-assessment," Nanjing, 2012.

[25] I. Colthart, G. Bagnall, A. Evans, H. Allbutt, A. Haig, J. Illing and B. McKinstry, "The effectiveness of self-assessment on the identification of learner needs, learner activity, and impact on clinical practice: BEME Guide no. 10.," *Medical Teacher,* vol. 30, no. 2, pp. 124-145, 2008.

[26] A. G. Asuero, A. Sayago and A. Gonzalez, "The Correlation Coefficient: An Overview," *Critical Reviews in Analytical Chemistry,* vol. 36, pp. 41-59, 2006.

[27] International Project Management Association (IPMA), ICB – IPMA Competence Baseline, 3 ed., Nijkerk: IPMA, 2006.

HYBRID PROJECT MANAGEMENT METHODOLOGY FOR R&D, INNOVATION AND R&D&I PROJECTS IN CFAA

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Abstract: *The aim of this research is to investigate about a project management methodology which fits to CFAA (a research center created by a public-private initiative in the Basque Country) in which different types of innovation, R&D and R&D&I projects are implemented. Authors seek to create a project management methodology to be customized for this Center to manage projects, programs and portfolios, and push the organization toward more agility and efficiency. The research methodology is based on descriptive study, reviewing of different resources such as books, articles, journals as well as interviews to determine the appropriate project management methodology to be implemented in this Center.*

Keywords: R&D project management approach, Innovation project management approach, R&D&I project management methodology, TRL 5 – 7.

1. Introduction

The Advanced Manufacturing Center in Aeronautics (CFAA in Spanish) was created with the aim of developing advanced manufacturing technologies located between the Technology Readiness Level 5 to 7 [1]. The CFAA was inaugurated in 2017 in the Technological Park of Biscay, also conceived by a conjunction of the University of the Basque Country (UPV/EHU) and the Business Cluster for the Development of Advanced Aeronautics Manufacturing Techniques. Together with the Basque Country Government and Provincial Council of Biscay, in collaboration with the Technological and Scientific Park of Biscay, enables the Center to focus on the end applications of aeronautics production, without forgetting the generation, use and fine-tuning of new knowledge in advanced manufacturing techniques.

Nowadays, the CFAA is formed by 76 partners, has had a total budget of about 2 million euros since his foundation, which has allowed to complete several projects in the different areas identified as vitals for the partners, government and university. 25 people are within the staff of researchers, 8 of them are doing their PhD and 7 of them are responsible for the project's coordination and research. It has also 8 professors from the University who share their time in the Center's research. There are also 20 people from partner companies working in the Center and 7 more are in dual training for partner companies.

This Center acts as an intersection of ideas and advancement for agencies and companies with capabilities and interests in the aeronautical engines and structural components sector, developing R&D, innovation, and R&D&I projects, which are complex projects with high level of uncertainty and risks [2].

1.1. The importance of project management

Implementing a project management methodology carry out great improvements on the KPIs of a company. The Centre for Business Practices (CBP) reported 75% improve in employee's productivity; besides 27% improvement in return on investment (ROI) and 30% improvement in budget performance as well as 50% more projects completed. Customer satisfaction increased about 38%, as a result of implementation of project management methodologies. Moreover, project management not only has positive impact on the organization, but also on the employees' satisfaction by increasing employees' satisfaction 40% CBP, also Thomas and Mullaly [3] reported 58% improvement in employees' quality of life.

Although there is a wide range of projects in CFAA, the lack of comprehensive and customized project management methodology is noticed. In order to clarify the importance of project management, this research review the statistical reports regarding projects' success rate through implementation of project management. Considering the statistical reports regarding the projects' success rate directed the authors to concern about conceptualizing the customized project management methodology for CFAA. To achieve this goal, firstly the identification of the current situation of the projects in CFAA is essential.

1.2. Project management in CFAA

The activity of the CFAA is centered around the planning and realization of projects included in a List of Projects (LOP), in which the intensive use of the resources is sought in fulfillment of the aims of the Centre. This LOP is prepared on the basis of the proposals made by each of the members of the Centre, sent for study and acceptance during a period of the year by a Technical Committee. The duration of the project depends on the planning that is done between the partner project's lead and the Centre, taking into account the disposition of its resources, which is established according to the order of arrival of the requests, followed by the hierarchy of the partners.

Table 1. CFAA Partners summary (2019), classification by type and industry

Type	Industry	Quantity
A	Large size machine tools	1
	Tier 1 Aeroengines	1
B	Cutting-tool Medium size companies	3
	Machine-tools Medium size companies	1
	Metrology companies	2
	Metrology and Additive manufacturing	1
	Machine-tool Small size manufacturers	1
C	Additive m.– machine developers	1
	Cutting tools and accessories	1
	Digital Transformation	1
	Engineering services	1
	Tier 2 Aeroengines	2
	University	1
	Welding equipment and consumables	2
	Work holding	2
D	Additive manufacturing – services	1
	Cutting tools and accessories	31
	Digital Transformation	5
	Engineering services	4
	Technology providers	1
	Work holding and fixtures	5
SC	Digital Transformation	1
	Engineering services	4
	Industrial Clusters: a) machine tools and b) aeronautics	2

During those three years of operation, the existing control mechanism for the project management in the Centre was the LOP, which produce that the planning of activities and scheduling the use of machines and human resources, depended entirely on this file. This way of managing was adopted because of the need to control the activities that were carried out in the Center; however, no project management methodology had been considered for its subsequent implementation and daily use. Likewise, a large percentage of the projects that had been approved in the LOP are pending (Table 2), either due to the lack of information from the Partner (principal interested in the realization of the project) or the lack of resources for its realization. The absence of the proper information necessary for the realization of these projects such as resources needed, time foreseen, main tasks, stakeholder analysis and even the objective of project is experienced, which increase the difficulty of projects' realization for the project's coordinators of the Centre.

Table 2. Projects resume - CFAA

Year	Complete	Pending
2017	69.12%	30.88%
2018	74.36%	25.64%
2019	42.16%	57.84%

1.3. Innovation projects and R&D projects characteristics

CFAA projects are mostly innovation, R&D and sometimes R&D&I projects. In order to manage these projects, it is essential to examine about the characteristics and identification of such projects. Mikulskiene [2] stated that R&D projects are complex projects with high level of uncertainty and high risks, including highly intelligent activities, which are associated with barriers, dramatic collaboration change, breakthroughs and the quality is judged by experts; furthermore, the goal for R&D projects is "ambitious", "optimistic", and "challenging; therefore, Stuckenbruck [4] stated that renewing the goals and rethinking of ideas as well as changing the methods happens during R&D project; besides Energy Facility Contractors Group [5] described the progressive scope of R&D projects, which can be reached to the stable situation through iterative researches.

Since R&D projects don't have defined-goals, process and detailed planning in initiation phases are not possible, producing that the managing of such projects a not easy task. Mikulskiene [2] mentioned that there are a lot of issues in managing R&D projects related to planning, resource allocation and scheduling since R&D project should have flexible planning to cope with new methods and changes.

Furthermore, in CFAA are innovation projects, which in turn have the non-linear process [6] and are associated with remarkable challenges such as the possibility of failure, the high rate of ending up projects without any results, the variable project scope, the long-lasting project life cycle, the conflict between researchers' interest and companies' interest, difficulty of bounding innovation projects to defined time periods and planning, and not-fixed scope of innovation projects which is changing due to internal and external factors [7].

2. R&D project management and innovation project management approaches

To manage innovation and R&D projects, Mikulskiene [2] referred to tow-stage R&D project management. The first phase, planning, is more technical rather than the second step which is associated with human resource issues, stakeholders, partners and team.

Stuckenbruck [4] represent four-phased project management life cycle, which is a linear approach that includes project concept, project planning, project implementation and project completion. Setting up abstract goals, having flexible planning, focusing on constrains and the

environment is recommended in this methodology. Kerzner [8] represented a five-phased of project life cycle to develop new products including: conceptual, planning, testing, implementation and closure phases. Overlapping phases and break down a long-lasting product development project into smaller projects are specifications of this approach.

Six-phased life cycle as the best R&D project is also in alignment with above-mentioned approaches. Although four-phased, five-phased and six-phased life cycle is defined in different phases with detailed information, the appropriateness of them are under question, since these approaches have linear structure; while R&D happens in non-linear phases [9].

Reviewing the literature on R&D project management clarify the need for non-linear structure for going back to general idea and detailed planning at the beginning of projects is inevitable due to the characteristics of R&D projects. To summarize, although phased-life cycle approaches are needed to clarify the whole process of R&D project management, the non-linear approach should be defined to provide the chance for more creativity, flexibility and changes in general ideas, primary planning and used methods and technologies, in addition, the need for iterative and incremental research phase are essential to overcome the progressive scope and narrow the changes.

To manage innovation projects, different methods has been discussed. Phased project planning (PPP) is a control mechanism for New Product Development (NPD), introduced by NASA to guarantee that the NPD projects will be implemented according to the plan and delivered on time. However, the engineering driven PPP approach was too time consuming and too bureaucratic [10]. To cope with the limitation of PPP approach, Cooper [11] introduced stage-gate system approach, which is a quality-focused framework that contains different stages, each one has its own inputs and deliverables which are assessed, checked and approved before continuing to the next stages. Although stag-gate approach considered the business case and focused on the market, this approach does not provide the opportunity for creativity and innovation as a result, a hybrid methodology is suggested to mix the agile methodologies and traditional methods.

3. Hybrid approaches in innovation project management and R&D project management

Gutiérrez et al [12] developed a new R&D project management methodology for NPD, he combined the classical project management theory and some of the best practices in the scrum. This methodology includes definition, design, development, testing and release phases. Is also associated with several benefits such as quick feedbacks from customer sides derived from a scrum approach in development phase and controlling all aspects happens in release phase, in addition saving money and time through redesign cycles and testing the usability and functionality of the deliverables during sprints in development phases. Figure 1 represents this methodology.
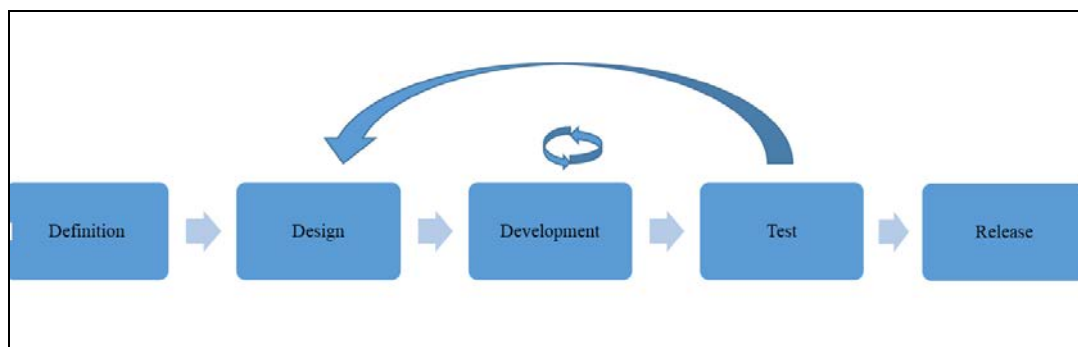

Figure 1. R&D project management methodology [12]

Cooper [13] represented the triple A approach which is a hybrid structure of Stage-Gate and agile approach. Triple A stands for adaptive & flexible, agile, and accelerated. Adaptive comes from the team adaptation to the context of the project, and agility happens during iterations and spirals.

Perez and Louw [14] represented Fugle Innovation approach, which is the combination of stage-gate approach with the agile approach. This approach relay on innovation process and carried out internally, but connected with the external environment and out sourcing, overlapping stages and iterative loops are the possibilities of this approach. This is also applicable in both product manufacturing and service providers and rely on innovation including the whole innovation process.

Sommer et al. [15], introduced the industrial scrum, which is the combination of stage-gate approach and scrum. In this approach, the organizational level applies the stage gate approach, while the project level used the scrum.

However, still one question exists that how decision making over combining two approaches happens. Fijn [16] represented a positioning model through that decision making over combining approaches is facilitated. In this model, the linear structure and the level of control over the environment are main axes for decision making. To manage projects with linear structure in dynamic environment triple A approach is suggested, while for non-linear structural projects, the combination of stage-gate and agile approaches should be applied. Figure 2 shows Fijn positioning project management approaches.
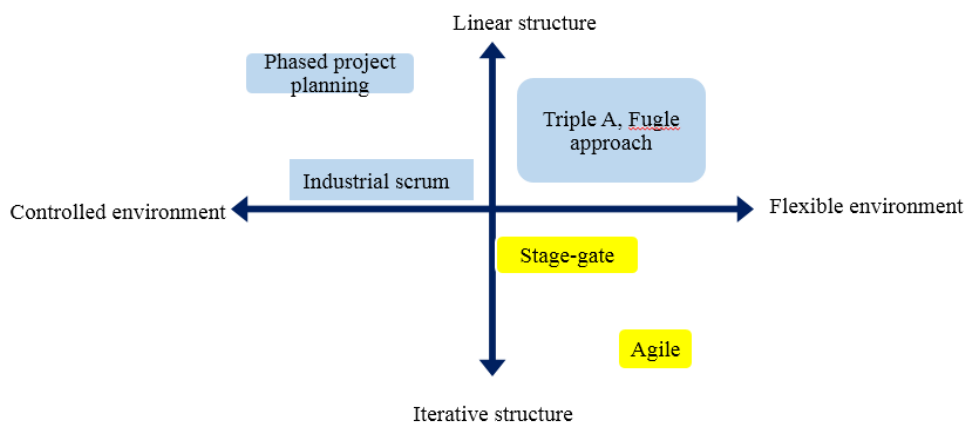

Figure 2. Fijin positioning project management approaches [16]

4. Hybrid project management methodology for R&D, innovation and R&D&I projects in the CFAA

Taking into consideration the characteristics of R&D projects and innovative projects as projects with ambitious goals, not fully defined methods and non-linear process, directs the authors to create a nonlinear and hybrid methodology for managing the R&D&I projects. The bases of the methodology are summarized as below:

According to the Fijn [16] positioning project management approaches figure (2), the suggested hybrid methodology will be a combination of stage-gate and agile approach since the identity of the projects are mainly R&D and/or innovative projects, which have the non-linear process and implemented in a non-controllable environment. Taking into consideration the tow-stage R&D project management [2], four-phased project management life cycle [4] and five-phased of project life cycle [8], the authors come to the conclusion that phased-life cycle approaches are needed to clarify the whole process of R&D project management. In addition, based on Energy Facility Contractors Group [5], the need for iterative and incremental research phase are essential to overcome the progressive scope and narrow the changes.

Furthermore, deep investigation based on stage-gate system approach of Cooper [11] which is a quality focused framework leads to proposing the model consists of 6 phases, which each phase has its own inputs and deliverables and they are assessed, checked and approved before continuing to the next stages. Also, due to the fact that CFAA is involved in NDP projects and the new practical R&D project management methodology for new product development of Gutiérrez et al [12] in Figure 1, was an approved practical example for hybrid R&D project management methodology applied in the automotive industry and assumed as a role model in our investigation.

Table 3. Classification of projects CFAA – R&D&I

Type of projects	Percentage
Creation or development of new product technology platform	8.31%
Innovation	3.99%
Product or technology enhancement	46.84%
Project oriented to new product or process	40.86%

Reviewing the existing information and realizing interviews with the project coordinators and experts in CFAA, they provide some information about the fact that in CFAA there are innovative projects (Table 3), which in turn have the non-linear process, then, according to the Leydesdorff et al [6] the non-linear approach should be defined to provide the chance for more creativity, flexibility and changes in general ideas, primary planning and used methods and technologies as a result the backward steps are defined in this model.

Reviewing the literature surrounding hybrid approaches grabbed our attention over the fact that, the scrum approach cannot be completely applicable in this Centre since there are not remarkable software and IT projects in this centre, besides, although the iteration and increments are needed in each phase, the time constrains cannot be considered for them. Figure 3 illustrate the methodology.
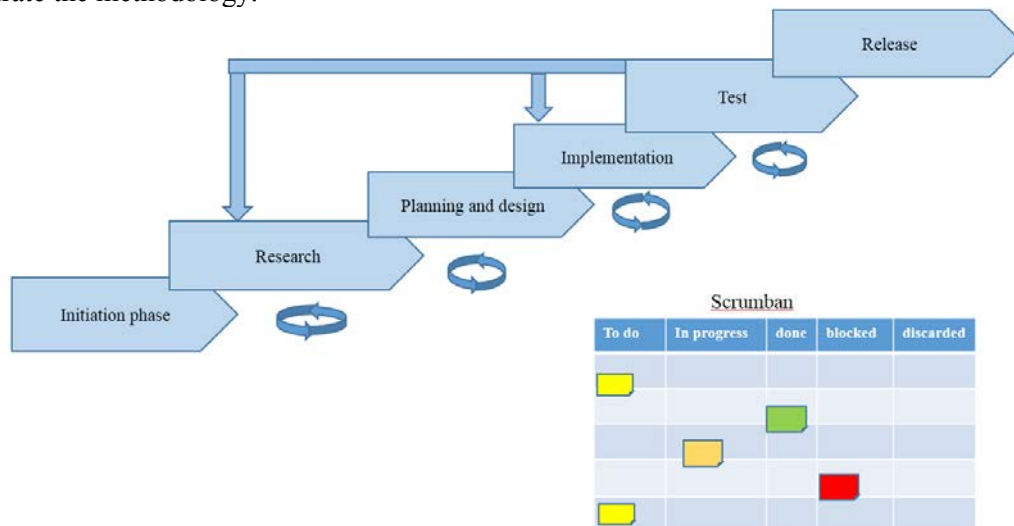

Figure 3. R&D&I project management methodology

4.1 Initiation phase

During this phase, a project is originated from the generation of an idea, and based on that, some requirements (duration, resources, budget, and initial scope) must be defined. An initial planning and project charter are recommended activities to do during this phase.

4.1. Research
This phase is applicable through (not time-boxed) iterations and spirals to do feasibility studies regarding the determination of methods, applicable technologies, tools and knowledge as well as narrowing the scope of the projects to reach the project scope baseline. Once it is done, a better perspective of the initial scope (it can be change in this phase), and the duration, resources and budget needed to do so, must be achieve.

4.2. Planning and design
The scope baseline and the results of the research will be used as an input for detailed planning of the project and design, if it is needed. Design and prototyping can be done through iterations and the final results should be presented or reported to the partners.

4.3. Implementation
During this phase, the activities planned must be done. To do so, can be used a Scrumban board to illustrate the status of the activities (to be done, in progress, done, blocked or discarded). Also, its recommended that the stand-up meetings in front of the scrumboard for issue tracking and problem solving to be done.

4.4. Test
Test and measuring the results as well as quality control happens in this stage. If the deliverables do not meet the desired results (defined in Phase 3), iterations provide the chance for more tests, also backward to design and implementation is possible.

4.5. Release
This phase consists on activities such as installation, delivery, reporting and final representation for partners, documentation and lesson learned meeting and evaluation.

5. Conclusion

The proposed project management methodology has several characteristics which seem to fit for R&D, innovation as well as R&D&I projects. In fact, the stages and phases of this methodology guarantee the control and monitoring ability, while the iterations and spirals which derived from the agile approach provide the chance for flexibility, learning and responding to the flexible environment. Besides, iterations in research phase are essential to narrow the changes of progressive scope and finally reach the scope baseline. In addition, overlapping stages increase the fluidity and the possibility to have parallel activities.
This methodology paves the way for going back toward applied-methods to edit and modify them according to the feedbacks received from the main stakeholders. Furthermore, application of Scrumban board in the implementation phase is a proper communication tool that illustrates the status of the activities (to be done, in progress, done) as well as the blocked or discarded activities, which decrease the efficiency of the projects. Stand-up meeting during the implementation phase is strongly suggested especially for the problem solving and accelerating the speed of the work in progress. The last but not least, knowledge storage and sharing in release phase provide the chance for similar projects in the future to use the knowledge.
This methodology has been extended and been approved to be used in the CFAA by the project managers in the Centre. The project coordinators will apply this methodology in several projects to evaluate the usability of the proposed project management methodology. This methodology is a main component from a whole system of project management that will be implemented in the CFAA during the second semester of the year.

6. References

[1] CFAA. Mission. Available at: https://www.ehu.eus/en/web/CFAA/eginkizuna [Accessed 20 May 2019]. 2017

[2] B. Mikulskiene: Research and development project management, study book, Mykolas Romeris University: www.mruni.eu 2014

[3] Thomas, J., Mullaly, M. Guest editorial: explorations of value: perspective on the value of Project Management. Project Management Journal 40 (1), 2–4. 2009

[4] L.C. Stuckenbruck: The implementation of project management: The professional's handbook (p. 1-23). MA: Addison-Wesley Publishing Company. 1981

[5] EFCG Energy Facility Contractors Group (EFCOG) Project Management Working Group, project management in research and development, white paper. 2010

[6] L. Leydesdorff, D. Rotolo, W. & de Nooy: Innovation as a nonlinear process, the scientometric perspective, and the specification of an 'innovation opportunities explorer. Technology Analysis & Strategic Management, 25(6): 641-653., 2013

[7] D. Csaba: Managing Innovation Projects versus Ordinary Project Management: https://www.researchgate.net/publication/319015297, 2009

[8] H. Kerzner: Project management: a system approach to planning, scheduling and controlling. Wiley & Sons, Inc. Tenth edition, 2009

[9] R. Nelson, & S. Winter: An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge, Ma. 1982

[10] R. G. Cooper: Third generation new product processes. Journal of product innovation management 11(1): 3-14, 1994

[11] R. G. Cooper: Stage-gate systems: a new tool for managing new products. Business horizons 33(3): 44-54., 1990

[12] R. Gutiérrez, J. Canela, F. Artés, & T. Femenías: Experiences in agile project management for new product design and development in the automotive industry. Tmt.unze.ba. https://www.tmt.unze.ba/zbornik/TMT2012/050-TMT12-165.pdf, May 20. 2012

[13] R. G. Cooper: What's Next? After Stage-Gate. Research-Technology Management 57(1): 20-31., 2014

[14] N. Preez, L. Louw: A framework for managing the innovation process. PICMET '08 - 2008 Portland International Conference on Management of Engineering & Technology., 2008

[15] F. Sommer, Hedegaard: Improved Product Development Performance through Agile/Stage-Gate Hybrids: The Next-Generation Stage-Gate Process?" Research-Technology Management 58(1): 34-45., 2015

[16] E. Fijn: innovation projects and their promising project management approach, exploring the influence of context factors on the choice in project management approach (Master of Science Thesis at Delft University of Technology)

DEVELOPING A PRACTICAL FRAMEWORK TO MANAGE HYBRID-AGILE PROJECTS FOR COMPANIES WITH A TRADITIONAL PROJECT MANAGEMENT APPROACH

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Abstract: *The desire to be benefited from Agile refers not only to software development companies, but also to manufacturing companies or many other industries. This can be explained by the hope to leverage the benefits of flexibility, fast results and precision in case of fulfilling the customers' requirements. However, the toughest challenge is to apply this approach and use make use of benefits for companies with a traditional, inflexible environment and resistant to change. Moreover, these companies struggle to start applying new approaches due to huge amount of information that need to be considered. This is only one of the reasons, why companies hesitate of even fail applying agile approaches. This paper suggests a framework helping companies to start their first hybrid-agile project in the field of process optimization. Based on the literature research and conducted interviews the framework includes all the necessary components for the successful start for the companies, which follow traditional approach.*

Keywords: project management, agile, management approach, hybrid-agile projects, process optimization.

1. Introduction

Nowadays the tendency to be agile is becoming more and more vivid, not only in companies focusing on software development, but also in various other industries [1]. The desire to be modern, deliver results faster and focus on customers' requirements makes huge international companies apply agile approaches [2] even though they have usually only experience in traditional project management "[(further PM)]". That raises many challenges and obstacles in the daily routine of the business, for instance lack of knowledge and experience in estimating results as well as issues related to people, business processes issues as progress estimation, and more others [3]. In fact, many companies, which want to benefit from the agile philosophy, have difficulties in a huge variation of tools and techniques that can be used within agile [4]. Those companies are continued by inertia to carry out projects following the traditional methods, and partly change the waterfall approach to Scrum [5]. There is an evidence that such combination of traditional and agile PM can be beneficial for companies [6]. In addition, there are existed many different agile methodologies that can be implemented to companies and applied in projects according to a number of factors, related to the inside and outside environment of the project, people, corporate culture and others [7]. Furthermore, it is not only important to know about agile methodologies, but also essential to understand how this integration of agile in the traditional PM environment is executed [8].

Within this paper, theoretical concepts of PM approaches in general and main roles are discussed in the first part. This is followed by the overview of exist hybrid-agile frameworks and models. As a third and main part, the framework for carrying out hybrid-agile projects within companies with traditional PM environment is developed. Finally, a discussion will cover the expert opinion to the developed framework, followed by the conclusion.

2. Research Approach

A scientific approach was followed by gathering publications of the relevant journals of PM, considering previous studies not older than 2014 with their respective sources. There were not only research papers used, but also relevant published literature. In this process the keywords were used as "Traditional project management", "Agile project management," "Process optimization", "Agile roles", "Hybrid frameworks", "Stage-gate" and "Hybrid-agile" including their variations. As a result, 125 different papers and books were pre-selected. The next step, all the found materials were skimmed and separated into two main groups: "relevant" and "potentially interesting". The "relevant" materials were separated into sub-groups "project management approach", "hybrid-agile models and frameworks" and "supportive". All the findings were collected and were the basis for the own framework, that was further developed.

3. Project management approaches

PMBOK [9] states that PM is "the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements". Project management as a profession appeared in the middle of the last century and since then has been constantly developed and gained knowledge, methods and approaches are considered as foundation for solving huge number of challenges (projects). In the paper two main approaches are described: traditional and agile.

3.1 Traditional project management approach

Traditional PM is known as a common practice that fit to the most of projects and can be applied in order to reach the desired results by meeting the requirements of the time, scope and costs, which are also known as 'iron triangle'. Moreover, these projects have defined outcomes, are carried out in a linear way and all the actions can be planned with relatively small changes [10]. It is a predictable approach [11, 12], that include tools for planning, (e.g.: network diagram, Gantt chart, milestone plan etc.), monitoring and controlling (e.g.: KPI's, dashboards, reports) as well as other methods to support executing projects [9].

PMBOK [9] divides PM process into five main process groups such as Initiation, Planning, Executing, Monitoring and Controlling and Closing, and furthermore provides certain tools and techniques to accomplish each of the stage.

Similarly, PRINCE2 [13] describes PM standard in stages (pre-project, initiating stage, subsequent delivery stage(s), final delivery stage) with a wide number of process groups (starting up a project, directing a project, initiating a project, controlling a stage, managing product delivery, managing a stage boundary and closing a project) as well as levels of delivery (directing, managing, delivering).

From the very beginning, PM has been considered as traditional. The standards of PM have their aim to fit to the majority of projects, but it becomes clear that "one size fits to all" approach does not meet the needs of today's world [8, 10].

Table 1. Overview of the traditional PM roles (based on [9, 14])

ROLE	DESCRIPTION
PROJECT MANAGER	• Responsible for the leading the team • Efficient planning and managing of the project within time, scope and budget
PROJECT TEAM	• Supports the Project Manager among the project
PROJECT SPONSOR	• Provides Project Manager with resources and authority and makes the final decision
PROJECT OWNER	• Acts on behalf of the Project Sponsor to make sure that the project replies to its interests
PROJECT STEERING COMMITTEE	• Ensures the project progress according the plan
PROJECT PMO	• Support the PM standard in the company and has different scope of responsibilities, depends on the needs of the company

In the traditional PM there are number of roles exist in the project (Table 1). The list of the roles is not limited by the described ones and depends on a company structure as well as the project structure. In addition, there might be more responsibilities for each role than described. The current paper does not have the aim to name all of them. Only the roles that have a direct link to the main challenge are given.

3.2 Agile project management approach

With the appearance of the Agile Manifesto [15], ideas of agile has started to attract more and more companies from different fields by the flexibility, open-minded attitude to changes, and collaborative way of communication with the client. It is an adaptive approach that emphasizes more the practical side of the project, rather than bureaucratic. This so-called agile philosophy follows certain principles, for instance, customer satisfaction via early delivery of a working product, respect of changes suggested by the customer or working with motivated and self-organized team [15]. It can be summarized, that a typical agile project is a project with high uncertainty in the way it should be delivered, fast delivery of the results and constant improvement during execution [10].

Similar to the traditional approach, agile also can be divided into phases or stages. More often, it is also linked to methods used, for instance Scrum. Scrum is an iterative and incremental method of agile that has its cycle divided into phases: Product backlog, Sprint Planning, Sprint backlog, Daily scrum, Results, Sprint Review, and Sprint Retrospective. All of these steps are mandatory to be carried out and follow strictly a times schedule. For this method it is crucial to collaborate with the client along the whole project, making the product as valuable as possible and meet all reasonable needs. After every Sprint, the complete product or an increment (agreed elements) is presented to the client, the so-called product owner. [16]

The benefit of the method is that the client receives the product at the early stage and is able to make changes without greater harm. The possibility to get a highly valuable result immediately is higher than with the traditional waterfall method. With the traditional methods, the presentation of the final product is very late, the budget is spent, development time is over and all further changes are lead to additional costs of money and time and sometimes difficulties in changing the overall product [17]. Following the scrum methods, certain roles exist in all projects – the scrum team (Table 2).

Table 2. Overview of the agile roles in scrum (based on the [16])

ROLE	DESCRIPTION
PRODUCT OWNER	• Responsible for the value maximization of the developing product and ROI • Role is dedicated only to the one person, but he can be a representative of an interested in the result group of people
DEVELOPMENT TEAM	• Consists of specialists from different knowledge areas that are needed and responsible for the product delivery • Recommended that it should be between three and nine tem members
SCRUM MASTER	• Helps both the team and the owner to be successful by clarifying rules, values, principles, practices of Scrum • Interacts and support overall organization in questions of Scrum

These mentioned roles are involved in all agile projects, not only within the frames of scrum. In agile, there is another role worth to mention: Business analyst role [12]. It is the bonding between the team and the product owner in case of transferring the real value need to the team and technical explanations to the product owner, in order to make the requirements (user stories) more valuable and manageable to the final product.

4. Overview of existing hybrid frameworks

There are many different frameworks based on the combination of traditional and agile approaches discussed in the literature [1, 6, 17, 18]. However, the majority focus on IT and product development to the final customer in external projects and only a little that study the agile

approach for the process improvement [19]. In the following, there will be given short explanations about existing hybrid models and frameworks.

- *Agile-Stage-Gate-Hybrid* model by Cooper and Sommers [18] has a focus on manufacturing companies. The combination of agile (scrum) and traditional (stage-gate) approaches in this model allows managers focus on both macro and micro planning. The agile is focused on operational level (execution of the project, deliver the value to the client). The stage-gate focus on the strategic level with general planning and support communications between projects. In other words, scrum method can be implemented on the developing and testing steps of the project, but with one important difference from the software development. [17, 18]

- *IVPM2 (Iterative and Visual Project Management) Hybrid framework* by Conforto and Amaral [6] was created by Conforto and Amaral in 2010, based on the ideas of Cooper [17, 18] about combination of agile and stage-gate approaches. There are existing five dimensions as well as seven-stage cycles that have an iterative nature. The main idea of the concept is lying in creating three levels for planning and controlling. First one is related to overall planning of a project and its deliverables (mainly stage-gate); second – iterative development ('sprints'), where the deliverables are braked down into smaller packages, that need to be prioritized and carried out during time-boxed periods of time; the third one – performing on the daily basis. By the idea of the authors, all the levels are integrated by a PM software. The aggregated data from the software is a source for project manager to make various reports and track the project progress. [6]

- *Hybrid Innovation Management Framework* by Brandl, Kagerer and Reinhart [1] has its focus on manufacturing companies. Also, as a basis of the framework the stage-gate approach and agile approach were taking into consideration. According to the paper [1], the designed framework should have seven main elements (or systems), including project scaling system, resources, performing reports, tool support, innovation objective system, agility assessment and hybrid process system as the central one. The last three mentioned systems are the basis for the stage-gate macroplanning of the project. The proposed framework was not practically proved, but all elements were gathered based on the literature and experts' opinion. [1]

- *Agile Business Process and Practice Alignment Methodology* by Martins and Zacarias [19] The focus of the framework is on business process optimization. Martins and Zacarias [19] take Business Process and Practice Alignment Methodology (BPPAM) [20], that has a traditional nature and a strict division into three phases: discovery of business process, supervision and its assessment and improvement, and modify it into agile BPPAM framework by merging two last phases into one. According to the authors, this methodology is based on the day-to-day practice and has into consideration the separation between practice and processes that are needed to take beneficial for company decisions. [19]

5. Designed Three-Level-Framework

Due to observed potential in literature, it was decided that the framework will consider the internal projects related to the process optimization.

The Framework (Fig. 1) consists of three main levels, which serves the company to bring it from pure traditional PM approach to the mixed traditional approach with agile superstructure. Each of the level that has their own goals. The first *"Start it!"* level has the aim to make a company to be ready for the following changes; the second *"Run it!"* level has a goal to carry out the hybrid-agile internal project with a help of specially developed operating model (OM); the third level called *"Adopt it!"* – with the aim to support the decision on future use of the hybrid-agile approach in the company by thorough examination of the result and the used approach.
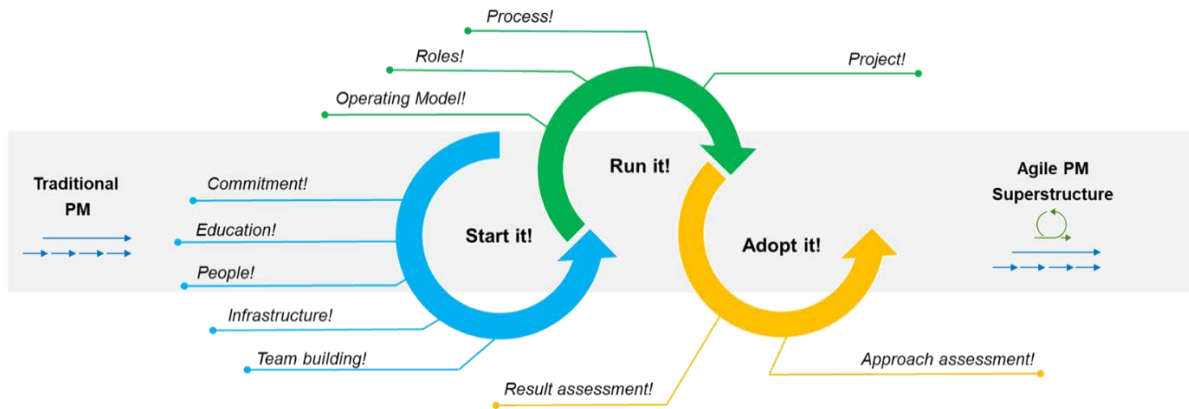
Figure 1. The Three-Level-Framework (own illustration)

5.1 The "Start it!" level

For a company, which wants to be state-of-the-art, follow new trends in managing projects and, what is more important, be successful with this novation, is extremely necessary to prepare the personnel to this novelty. Therefore, there should be actions taken, related to Organization and Project. At Fig. 1, there are five main areas that need to be covered at this level, such as Commitment, Education, People, Infrastructure and Team Building.

- *Commitment!* Buy-in from the top-management. Projects should gain the top-management support for successful work in the future. Exactly for this reason, in the operating model "[(Further OM)]", which is described further, one of the roles is dedicated to a management representative, who will observe and participate in the project meetings, getting "first-hand" information from involved roles. It would be beneficial if this is an active, inspired, open-minded person, who has a desire to dive into agile philosophy to spread the spirit among the top-management.
- *Education!* Organize trainings and seminars for the stakeholders. Next point is related to the overall understanding of the agile philosophy in a company. To create a fruitful environment and right attitude, there are some marketing actions needed (e.g. leaflets with benefits and main attributes of the philosophy). In addition, seminars and trainings need to be organized for the main stakeholders in order to introduce agile philosophy and explain the desired outcomes.
- *People!* Assign propriate employees to the project. The big advantage for big companies comparing to the small organizations is the accessibility of more employees and therefore, a high chance to select the right people. For agile projects, it will be beneficial to have open-minded, excited and motivated people, who would like to try something new. They should be ready to work with uncertainties and their background is important as well. The agile philosophy demands to have highly motivated on the one hand and self-organized ones on the other hand [15].
- *Infrastructure!* Organize convenient infrastructure for the team. Another critical point is to provide the convenient location to work in teams, to have access to collaborative zones and private areas for personal work and concentration. The location should be properly equipped with white boards, post-its, markers, computers and other attributes for the efficient work.
- *Team building!* Organize team-building events for the project team. Last but not the least, team building activities for the development team should be organized upfront. Team building events, organized beforehand can help to minimize the length and destructive components of first stages and to come up with efficient and effective working mode as early as possible.

As a plus, before the actual start of the work at the project, it is suggested to have a get-to-know session, where all the participants can express themselves, their fears and ideas, experience and

suggestions. It is critical to create the atmosphere of trust and non-judgment, and to develop good communications between the parties.

5.2 The "Run it!" level

This level is the core of the framework. It describes how a company will manage the internal project (*Project!*) in mixed agile and traditional way. Therefore, the OM (*Operating Model!*) is introduced, including roles and responsibilities (*Roles!*) as well as processes (*Process!*), which are necessary.

The idea of the OM is based on the articles of Conforto and Amaral [6] and Martins and Zacarias [19] with own perceptions and further amendments. The OM will follow the hybrid top-down and bottom-up approach in carrying out of the internal (e.g. process optimization) projects, despite some models of process development that were described by Martins and Zacarias [19]. It is made to underline the importance of effective and efficient collaboration of management and working people on the one hand, and involve the people to prevent further resistance of working in new conditions on the other.

The OM is divided into 2 layers (Fig. 2): Traditional (Stage-Gate) layer and Agile layer. For the convenience, the elements that are related to agile will be marked in green color; the elements that are related to traditional project management approach are colored in blue.

One more element that is implanted into the OM is called "Software" and covers both layers and bond all the participants together. This platform collects user stories, back log, allows participants to leave feedback and place change requests; builds the reports and reflects the primary and final approvals.
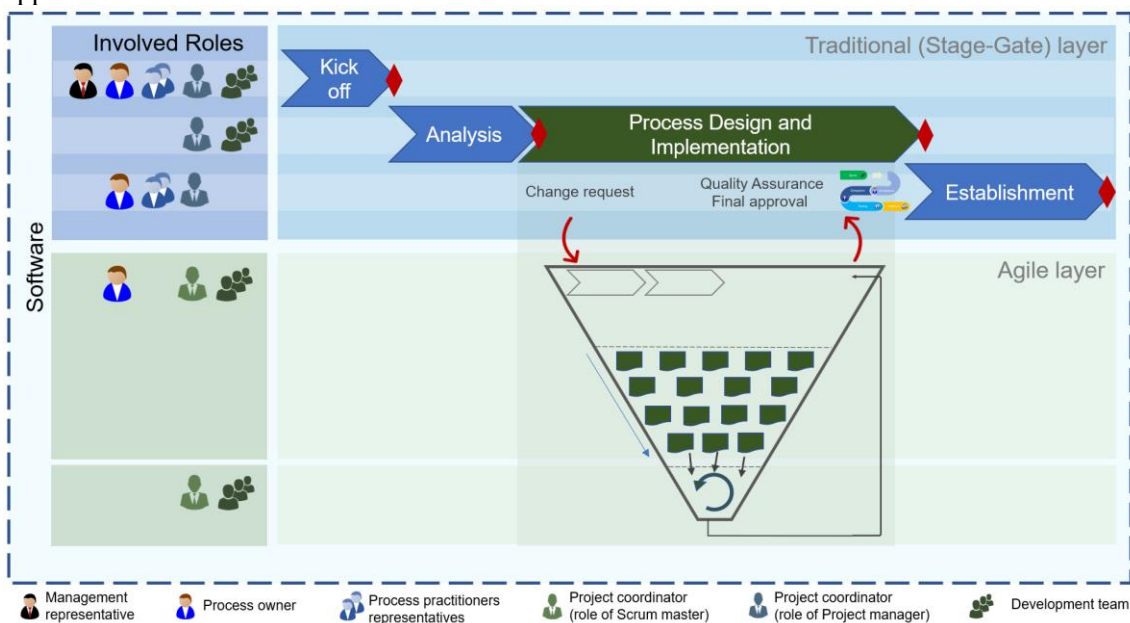

Figure 2. The Operating Model of the "Run it!" level (own illustration)

- **Traditional (Stage-Gate) layer**

Traditional layer is used for the tracking the progress, control the project and it is so-called interface for the management that makes the project seems familiar to the traditional environment with the usage of the project management language. The traditional layer can be called as macro layer and has its functions as traditional planning and overview of the project. It shows the stages that will be completed and marks the main milestones (meetings of all the participants). It has linear nature as a Stage-Gate. On the traditional layer, five main roles are presented, which are described in the Table 3.

Table 3. Roles and responsibilities (own table)

Roles	Traditional layer	Agile layer
Management representative	• The final approval and change request of the project scope. • Has the financial interest in the project (expected benefit) • Link to the top management and ensure top management commitment.	• *Not participating in agile layer*
Process owner	• Approval and change request of process and its sub-process, activities etc. • Quality assurance of the overall process. • Implementation (testing) the process received from agile layer. • Scaling the process within establishment phase.	• Development of user stories. • Prioritization of user stories. • Feedback to the Development team. • Change requests and acceptance.
Process practitioners representatives	• Source for the data within analysis phase. • First users of the process within implementation (testing). • Feedback from implementation.	• *Not participating in agile layer*
Project coordinator	• Planning and controlling functions of overall project • Budget responsibility of project • Reports to Management representative	• Coordinate the team (instructions, time, infrastructure etc.) • Protect the team from interfering of management/ stakeholders • Support Process owner with user stories • Facilitate agile philosophy to the company
Development team	• Collect data for analysis • Conduct interviews and other activities • Analyze data and interviews	• Work on user stories • Deliver results • Present results to process owner

Especially for the key meetings it is necessary to invite process representatives, who are involved in the process, using the process on the daily basis. It is needed to collect their professional opinions to the process, thanks to which the development team can get more insights for the design stage.

There are four main stages in the operating model: *Kick off* (the official start of the project, that is carried out in a traditional approach), *Analysis* (stage to collect and examine the situation according the process (via workshops, observation, interviews) that needs to be optimized; can be both in agile and in traditional way), *Process Design and Implementation* (this stage is performed in agile manner and related to the actual creation or modification of the process with the further testing by the practitioners), *Establishment* (the stage in which the final documentation is issued, all necessary changes in job descriptions should be made, or/and the new job descriptions should be created).

The change requests of the scope can come from the Stage-Gate layer down to Agile layer. What is more, the decision to the acceptance of the results and progress also is done there. The quality assurance mechanisms should be verified and documented – it is important to make the process manageable and controllable for successful operation.

- **The Agile layer**

The second Agile layer (Fig. 2) is needed to accomplish the third stage "Process Design and Implementation". As it is shown at the Fig. 3, there are three small sub-layers: Process Increment layer, Back log layer and Scrum layer.

- On the Back-log layer, a backlog of user stories should be created and prioritized (1) by the process owner.
- The team, as in the scrum methodology [16], will chose which user stories will be handled during the sprint (2). The sprint is carried out by the development team and project coordinator only. It has strict duration of time and at the end of it team should finish the chosen user stories.
- Every sprint is tended to deliver (3) a finished process or its part (depends on the project).
- At the end of the sprint, after the delivery (3), the

Figure 3. Scrum component of the OM (own illustration)

process owner should give the feedback (4) to the team and decide, if the increment needs to be improved (5a) or it is ready to be tested (5b).
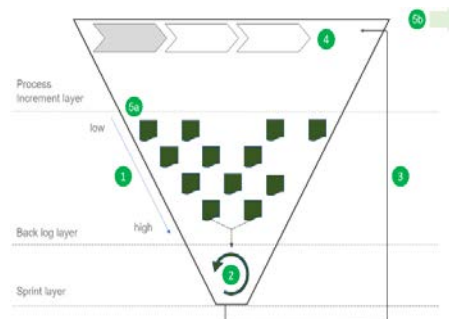
The main difference compared to scrum methodology is that the testing is executed by the process owner and representative group of process practitioners, following the so-called "Implementation Loop" (Fig. 4). After a sprint is finished, the process owner can decide (Acceptance) to test (Testing) a process increment by his representatives of the process practitioners (Delegation). After testing, the process representatives report the feedback to process owner (Feedback) and include a recommendation for further activities. There are two possible opportunities:
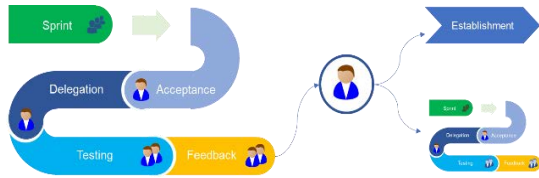
Figure 4. The Implementation Loop (own illustration)

1) Proceed to Establishment stage if the feedback is positive;
2) Return to the development team with a change request and start the prioritization.

The loop represents an implementation of the process. The process owner's responsibility is to assure the quality of the developed process and create the KPI's model for the further control over the process.

It is crucial to mention, that on the Agile layer the project coordinator has a role of Scrum master with the responsibilities to guide the team and protect it from the external interventions, assure that the team meets the requirements, clarifies the agile philosophy to the team members and other people.

The separation of the OM into stages and layers helps the project coordinator to steer and control the work of the team and protect the team from the interventions on the one hand, and gather all the interested parties at the right time and place, on the other hand; all the participants has clear and transparent picture and can track the progress.

5.3 The "Adopt it!" level

After the "Run it!" level, a company is not finished and further activities should be completed. After the process becomes a daily routine of the business, it is time to analyze the work that has been done to reach this result and give it an evaluation as well as evaluate the actual process.

The analysis can be done in two main dimensions: first, the component of the management and approach (Approach assessment!), that was used by a company; second, the analysis of result (Result assessment!) – process itself.

- *Approach assessment!* To manage this analysis, it is recommended to make a workshop as a retrospective with all the participants of this great way to agility. Certain questions should be discussed: What was advantages and disadvantages of the project? What worked well and what needs to be rethought? Which challenges did appear during the project and how they were treated? And others. The questions are not limited by the mentioned ones. All these insights and opinions should be analyzed by a company as well as documented. Based on the results, the management of a company can make an actual decision to continue using hybrid-agile approaches to carry out projects or not.

    In case, a company decided to proceed with his approach and use it for next process-oriented projects, the necessary changes in PMO of a company should be accomplished, if the PMO exist in a company, otherwise, it is suggested to create such a function.
- *Result assessment!* The assessment is recommended to do in one or two months after the project completion. It is necessary to let the process be a part of the organization, not separate from it. Three areas should be evaluated: *KPI's* (The comparison of the targets set for the process development and the actuals are important not only to establish the process, but also to control it in the future, make sure, that it is not going into the workarounds.); *Developed model!* (The new process model should be compared with the real process. All deviations should be documented and analyzed.); and *Practitioners' opinion!* (feedback from people who use the process on the daily basis).

All the information should be aggregated into the report, based on which the evaluation will be given. Important to mention, that for the objective assessment all three areas should be taken into considerations. It also might happen, that results from these areas are different. The result of the assessment will depend on the people, who will make the final decision that can vary from company to company.

6. Results

A practical framework was developed that has its aim to help companies with the traditional project management approach to manage projects with agile components. The framework consists of three main levels. The "Start it!" level guides a company how to begin with a combination of traditional and agile project, which activities should be executed and which aspects should be taken in considerations. The "Run it!" level presents an operating model, where a company can run the first hybrid-agile project in the field of process optimization. The "Adopt It!" level describes the post project events that should be accomplished in order to collect the output of the resulted process and the management practices from the new-to-the-company hybrid approach. The framework serves as a first-time-use by the company and then can be adjusted according the needs and decisions of the top management.

7. Discussion

In the following chapter the expert opinions on the framework were discussed. For the role of experts, practitioners with the agile experience were chosen, who work in the non-IT fields of business, due to focus of the paper. The list of questions and the experts' answers are provided in the Table 4. The practical experience is extremely important to give a strong opinion, on the one hand, and it assures the value of the opinion and recommendations on the other hand.

In the opinion of the expert A, the three-level-framework is consistent and easy to understand, as well as giving an overview for companies to start the hybrid-agile projects ("Start it!" level), and a guideline to reach a working level ("Run it!"). However, for the beginners, the description of roles and responsibilities as well as detailed activities could be more explicit, for instance in a "playbook". Expert A summarized with the conclusion that the framework can find its place and be used by the practitioners to start with the hybrid agile project management.

Expert B stated that the overall framework seems easy to apply to the reality, but also warned that the main challenges will appear during each of the level and be depended on nuances of each project, which are hard to predict. Moreover, this expert pointed out that the symbiosis itself always opens ways to develop something new, in this case, the two-layers Model ("Run it!") open the new approach to manage the projects.

There is also the space for improvements. The expert A suggested several areas for further development within the framework such as scaling the framework to manage several projects at the same time, including focus on the entire employees in a company, who might have touchpoints with the hybrid-agile projects. Furthermore, a focus for further improvements are ways to adjust the PM standards with hybrid elements, steering process for change requests from the top management to avoid the "power" pressure to the development team.

In addition, it can be stated, that the description, as well as roles and responsibilities are not fully detailed due to the focus on a holistic framework. It also contains more personal experience and attitude, rather than scientific. The second level "Run it!" can be specific in the topics as team dynamics, methods of process development and participants' roles and responsibilities. So far, the model has the minimum, with which the model can operate.

As a summary, the work was performed on a basis of literature research and solid own practical experience. The result has the expert opinion as "applicable for practice", which made the framework valuable for use.

Table 4. Questions for the interview with answers (own table)

Focus	Questions	Expert A	Expert B
Personal experience	Which experience you have with agile projects?	2 years	5 month
	Which industry you have made the experience?	automotive industry	energy supply
	Which roles you had while working in agile projects?	Scrum master, support of Product owner	Product owner
	Which challenges you have experienced and how did you overcome them? Which success factors have you identified?	"Crash of two words", lack of freedom, lack of transparency in showing the progress	Not acceptance of agile mode by some stakeholders
Framework assessment	What do you think of 3-level-model, if it is easy to be applied, in your opinion?	Easy to understand and can be applied, but should be more explicit with roles and activities	Seems easy, but will have hidden challenges depends on the company and project
	Which benefits and challenges you see in combination of agile and traditional approaches in the Run it! Model of the Framework?	Benefits: participants belong to their environments; early involvement of PO and practitioner Challenges: personality of the Project coordinator's role; decision point.	Quality outcomes as benefit, change of duration as a challenge
	Which attributes\parts\elements you found important in the Framework?	Training and team events at the beginning	
	Which potential for the improvements you see in the Framework?	Scaling, adjusting PM standards, steering of the change requests from management	Symbiosis of two different things is always leads to potential

8. Conclusion

The chosen topic embraced two different worlds of project management: traditional and agile. Nowadays, more non-software development companied are willing to apply new agile philosophy to be faster, more productive, more result oriented and, more successful. However, many companies are not aware of how to begin their agile journey.

As the result, a three-level framework was developed that will support companies to make the first steps in the direction of hybrid-agile projects and even has the first experience with it. As it was stated at the beginning of the paper, the framework will cover only internal process-oriented projects. Each level of the framework has its own functions and aims.
Finally, practitioners from industry and consulting provides their opinion on the developed framework. For that reason, the interviews with two experts were conducted. The background of the experts related to the project management, a practice of agile approach, a process orientation and non-IT industries. Both experts stated, that the framework is practically applicable with further improvements among the levels.

8. References

[1] F. J. Brandl, M. Kagerer and G. Reinhart, "A Hybrid Innovation Management Framework for Manufacturing – Enablers for more Agility in Plants", *Procedia CIRP* [e-journal] vol. 72, pp. 1154-1159, 2018.
Available from: https://www.sciencedirect.com/journal/procedia-cirp/vol/72 [Accessed 19 October 2018].
[2] C. Cobb, *Making sense of agile project management: balancing control and agility*, New Jersey: John Wiley & Sons, Inc., 2011.
[3] B. Boehm, R. Turner, "Management Challenges to Implementing Agile Processes in Traditional Development Organizations", *IEEE Software*, [e-journal] vol. 22, no. 5, pp. 30-39, 2005.
Available from: http://doi.ieeecomputersociety.org/10.1109/MS.2005.129 [Accessed 6 October 2018].
[4] Project Management Institute, *Agile practice guide*, Pennsylvania: Project Management Institute, Inc., 2017.
[5] J. Humble, J. Molesky and B. O'Reilly, *Lean Enterprise,* Sebastopol: O'Reilly Media, Inc., 2015.

[6] E.C. Conforto and D.C. Amaral, "Agile project management and stage-gate model—A hybrid framework for technology-based companies", *Journal of Engineering and Technology Management*, no 40, pp. 1-14, 2016.

[7] A. Rasnacisa and S. Berzisa, "Method for Adaptation and Implementation of Agile Project Management Methodology", *Procedia Computer Science*, vol. 104, pp. 43 – 50, 2017. Available from: http://sciencedirect.com [Accessed 7 October 2018].

[8] M. Špundak, "Mixed agile/traditional project management methodology - reality or illusion?", *Procedia - Social Behavioral Sciences*, [e-journal] vol 119, pp. 939–948, 2014. Available from: http//www.sciencedirect.com [Accessed 18 October 2018].

[9] Project Management Institute, *A guide to the project management body of knowledge (PMBOK guide)*, 6th ed, Pennsylvania: Project Management Institute, Inc., 2017.

[10] R.K. Wysocki, *Effective Project Management: Traditional, Agile, Extreme*, 5th ed, Indianapolis: Wiley Publishing, Inc., 2009.

[11] D. DeCarlo, *eXtreme Project Management: using leadership, principles, and tools to deliver value in the face of volatility*, 1st ed, San Francisco: Jossey-Bass A Wiley Imprint, 2004.

[12] R. Prakash and N. Agarwal, "Managing Business Analysis for Agile Development", *International Journal of Modern Engineering Research (IJMER)*,[e-journal] vol. 3 no. 3, pp. 1393-1395, 2013. Available from: www.ijmer.com [Acessed 16 January 2019].

[13] AXELOS Limited, *Managing successful projects with PRINCE2*, 6th ed, Norwich: TSO (The Stationery Office), 2017.

[14] O. Zwikael and J.R. Meredith, "Who is who in the project zoo? The ten core project roles". *International Journal of Operations & Production Management*, [e-journal] vol. 38, no. 2, pp. 474-492, 2018. Available from: https://doi.org/10.1108/IJOPM-05-2017-0274 [Accessed 1 October 2018].

[15] K. Beck, M. Beedle, A. Van Bennekum, A. Cockburn, W. Cunningham, M. Fowler, J. Grenning, J. Highsmith, A. Hunt, R. Jeffries, J. Kern, B. Marick, R.C. Martin, S. Mellor, K. Schwaber, J. Sutherland, D. Thomas, *Manifesto for Agile Software Development* [Online], 2001. Available from: http://agilemanifesto.org [Accessed 13 November 2018].

[16] K. Schwaber and J. Sutherland, *The Scrum Gude. The Definitive Guide to Scrum: The Rules of the Game* [Online], 2017. Available from: https://www.scrumguides.org [Accessed 14 January 2019].

[17] R.G. Cooper, "Agile–Stage-Gate Hybrids", *Research–Technology Management*, [e-journal] vol.59, no.1, pp. 21-29, 2016. Available from: https://doi.org/10.1080/08956308.2016.1117317 [Accessed 19 October 2018].

[18] R.G. Cooper and A.F. Sommer, "Agile-Stage-Gate: New idea-to-launch method for manufactured new products is faster, more responsive", *Industrial Marketing Management*, [e-journal] vol.59, pp. 167-180, 2016. Available from: https://doi.org/10.1016/j.indmarman.2016.10.006 [Accessed 19 October 2018].

[19] P.V. Martins and M. Zacarias, "An Agile Business Process Improvement Methodology", *Procedia Computer Science*, [e-journal] vol.121, pp. 129-136, 2017. Available from: http//www.sciencedirect.com [Accessed 19 October 2018].

[20] P.V. Martins and M. Zacarias, "Business Alignment Methodology: The Discovery Phase", *Information Resources Management Journal* [e-journal], vol. 27, no. 1, pp. 1-20, 2014. Available from: DOI: 10.4018/irmj.2014010101 [Accessed 10 March 2019].

BUILDING PROJECT MANAGEMENT: ORGANIZATIONAL AND TECHNOLOGICAL BASES ESTIMATION EFFECTIVENESS OF RENOVATION UNFINISHED BUILDING CONSTRUCTION

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Abstract: *Article is analysis of a basis to solve the problem in the organizational and technological aspects. Separate the individual aspects of the methodology completion of unfinished construction and schemes of unfinished construction. Organizational and technical training facilities renovation under construction - a system of interrelated technical, technological, organizational and economic measures taken to pre contractual stage of the investment cycle. Classification of organizational and technical schemes and organizational measures will fully justify pass algorithm uses of unfinished construction. The problem of organizational and technical training for assets under construction is complex and requires a comprehensive approach with deep processing options and assessment of cost-effectiveness of investment in the completion of these objects, play or diversification.*

Keywords: project management, criteria, renovation, the object of unfinished building construction, efficiency mark, organizational and technical parameters, market value.

1. Introduction

Unfinished projects have a special place in global market. Analysis of volume of unfinished building project (UBP) in Ukraine and Zaporizhzhia region (according to the Chief Statistical Office on 01/01/2016 [6]) shows that they are very significant [5]. All of this indicates a huge investment potential of unfinished building project market for construction in progress. Consideration of various regulations proves ambiguous interpretation of unfinished building project, because each of its position focuses not on object in general, but in his features, depending on scope or progress.

The problem of inexperience subject "unfinished building project" still at the stage of defining concept. This scientific question is still open and unresolved. Standpoint of theory - this is aggregate of building materials, but from practice standpoint it's separate type of real estate with inherent characteristics. Insufficient definition problem in general, lack of integrated approach to assessing its effectiveness, and great practical value, caused the consideration focuses of organizational and technical aspects. The purpose of article is to analyze problem solving in the organizational and technological aspect. Separate certain aspects of the methodology for the completion of UBP.

Project evaluation issues unfinished building project in the aspects of project management

Unfinished building construction project - object of construction, for which a construction permit has been issued, the costs of its construction have been incurred and not taken into operation in accordance with the legislation

Management of unfinished building construction project - activity attracted to the facility by Management Company that defines the goals and objectives of project, taking into account the

Management of unfinished building construction project - activity attracted to the facility by Management Company that defines the goals and objectives of project, taking into account the scope of work, resources (cost, labor, materials and others), project implementation time, its quality and possible risks.

Organizational and technical factors facilities renovation unfinished building project - system of interrelated technical, technological, organizational and economic measures stage of renovation cycle. Classification of organizational and technical schemes and organizational measures will fully justify pass algorithm uses of renovation unfinished construction [1].

The problem of evaluating effectiveness of investments in general for real estate in recent years has received significant development in the works of scientists [8], as regards the effectiveness of investments in unfinished building project - attention is primarily focused on the study of the valuation of such objects, but the relationship of the assessment to the needs of introducing these objects in the economic turnover through investment or missing, or only designated as a problem [7], without finding ways of its scientific and practical solutions. At the same time, a mandatory condition for evaluating effectiveness of investments in unfinished building project is to take into account the specifics of these objects, which will make it more reasonable to form a basis for the investor to make decisions about the feasibility of investing in objects, as well as to create a price for this object that would contribute to meeting the investor's interests in obtaining in perspective, income, the seller in obtaining income from the sale of the object, and society in the development of the infrastructure of the object, employment of the population during construction and operation and object, etc.

Correct, rational solution of problem of unfinished building project is seen through a qualitative survey, completion and commissioning objects, or their identification and elimination of hopeless real estate - as an "unnecessary" inheritance.

The peculiarities for property construction works in progress, as opposed to basic principles of Market Value determination, are as follow:

Each real estate is materially different: Construction works in progress are more different from each other than real estates in general. Although, according to the professional axiom, no two properties are the same since each one is situated at a different location, the varying extent of the completeness of real estates in this comparison adds another dimension. Therefore comparison of these items is even more difficult; practically no two facilities can be found that are comparable from a market aspect.

They are not circulating in the market: Unfinished constructions are not typically sold, since the developers know that completed real estate's having all of the licenses of the authorities are the sellable (end) products. Although in the wake of the crisis many offers appeared on the market of buildings with only a finished or a just commenced basic structure, such transactions are rare and therefore it is difficult to "price" their market.

They have very detailed technical specifications: In the majority of cases – with exception of long-discontinued or insolvent projects –construction plans and design drawings of works in progress are still readily available, as are their cost estimates and quotes, and all of the additional documents of their realization. This information is only partially available in case of the usual real estate market products; the older the completion of the construction is, the less likely it is that its technically relevant information is still accessible for the appraiser.

Their content (completeness, status) can only be determined through considerable technical surveys and analyses: While a completed real estate product can be described briefly and accurately – since it has attributes defined in standards and construction plans –, in case of an unfinished, abandoned construction it is very difficult to know where the implementation is standing on the way toward the finished end product. It is questionable whether the required construction documents are available, whether they accurately reflect the thus far completed

work, and whether the completed construction parts have not been damaged since the potential discontinuation of the project [2].

They do not generate revenue: Another valuation problem in case of yield-producing property works in progress is that while a finished product (shopping mall, office building) has known revenue-producing capabilities, which are supported by related previous statements, balance sheets, and contracts, these data are only forthcoming in case of planned investments. As seen above, in case of works in progress, the comparison of real estate's faces many challenges: the properties are not identical, and no market transactions exist in their relevance. Therefore traditional comparative market valuation can essentially be excluded from the potential methods.

Thus, the way of further project management consideration of subject is envisaged in consideration of "problem triangle", at apex of which placed such positions as modeling problems, study, consideration of path of optimization and grouping, creation of universal model of problem solving.

2. Priority formation of criteria of evaluation and selection optimum option of renovation of unfinished project

The discussion of value has become increasingly important especially as the question 'value for whom' (Winter et al., 2006) resonates in project delivery. But project management value has moved from ideas of 'value management' to ideas of 'understanding how stakeholders value different things'[4]. Reorganization unfinished building project, like any other project, from the emergence of an idea to its full completion goes through a series of successive stages of development. A complete set of stages of development forms life cycle of a restructuring project. The life cycle is usually divided into phases, phases - at a stage, stages - into stages. The project goes through four phases of development: concept, development, implementation, completion [3].

The initial phase of the project (development of the concept of reform) requires the following work: collection of basic data and analysis of the existing state (preliminary survey of the enterprise); identification of needs for changes (justification of the need for changes); result determination (goals, criteria, tasks, basic requirements and restrictions, risk level, project environment, potential participants; time required, resources, funds, etc.); definition and comparative evaluation of alternatives; expertise; concept approval.

On the basis of analysis of assessment methods of UBP and taking into account the requirements of the market, the author has developed a general algoritm for decision making on expediency of renovation of UBP and scheme of the implementation stages of process development strategy. (Fig. 1, Table 1).

The revealed technical, strategic, economic, financial and social motives of choosing a certain type of renovation, which will ensure the effective use of the object.
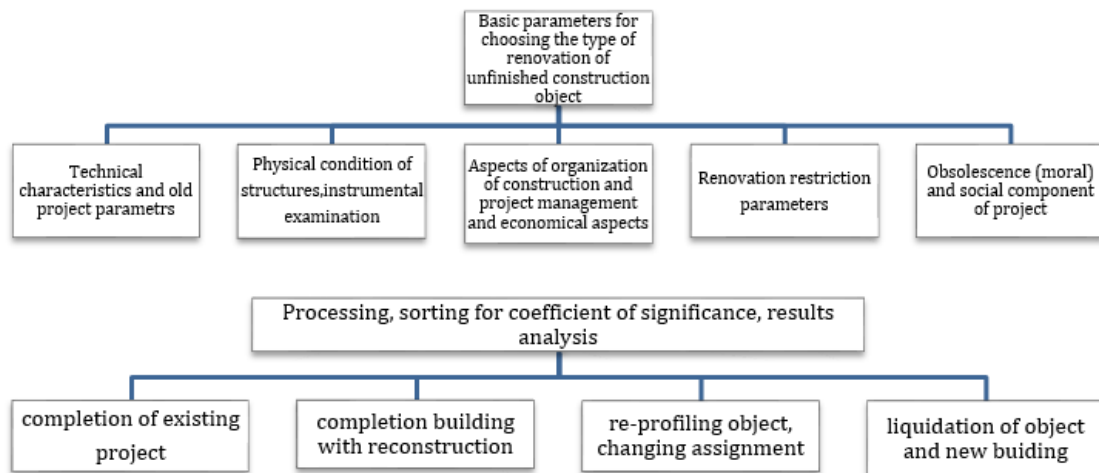
Figure 1. Main parametrs of decisions expediency of refinement unfinished building project

Table 1. Group of criteria attractiveness of unfinished building project for its physical characteristics

Criteria	Indicators
Readiness degree of unfinished building project	Ratio of current state of object completion to projected state, which characterizes it as completed.
Location object	Distance to the city center, to the main transport interchanges, industrial centers, etc.
The land-potential, which the object is located	Market price of land in area, number of offers and demand for these plots.
Functional object's purpose	Market value of objects of different functional purposes in the area, number of proposals and demand for objects of different functional purpose, number of transactions for sale of various functional purposes, profitability of activities using objects of various functional purposes in city.
Compliance of architectural and design solutions of an object with safety requirements, functionality of modern objects	Cost and time of reconstruction of UBP for bringing them to the level of compliance of the architectural and design solutions of the object with the safety requirements, functionality of modern objects.
Correspondence of architectural and design decisions of object to requirements of market	Opportunity, cost and time of preparation for the UBP for bringing them to the level of compliance with current legislation in field of construction in progress.
The social significance of object	Number of jobs-place that can be created after introduction of UBP, umber of social infrastructure objects. Number of residents of region who potentially can use UBP as a social object in the event of its appropriate functional application (school, sports, entertainment complex).

Investment management begins with decision. It is carried out after a thorough examination of the investment plan and, as a rule, is based on the consideration of the factors listed above. The influence of each such factor on the implementation of the investment plan is given a local assessment. To make a general decision, it is necessary to aggregate these local estimates into the corresponding integral estimate.

Consider the model of building an integral criterion for deciding on the effectiveness of investing in UBP.

For each of the above criteria, as a result of the project analysis, an expert assessment is set, with the maximum value characterizing the maximum compliance of specified criterion with expectations regarding efficient use.

The information base for the formation of assessments by experts are the indicators characterizing the severity of a specific criterion, the list and methods for calculating which will be analyzed taking into account the weight coefficients.

The most important thing for an investor is to achieve a high level of profitability with minimal risks, which is generally crucial for the implementation of investment projects (as for any type of business). All other criteria are largely dependent on the two.

It is also important to consider an adequate balance of opportunities and desires in the implementation of the project. For designers, it is most important to take into account the severity of the influence of the forced sale factor of unfinished building project, the functional purpose of unfinished building project, which is very problematic if the given characteristics of the UBP do not meet the market requirements, as well as the social significance of the UBP as a factor reflecting the interests of society and the importance of the unfinished building project for the development of the region.

3. Results and Conclusion

The author has developed a list of criteria characterizing the effectiveness of investing in objects of UBP from the point of view of obtaining profit.

In article presented main groups of parameters, and proposed model for deciding on effectiveness of investing in UBP. It should be considered that the most objective assessment of investment prospects should be comprehensive and take into account many aspects of the project, including taking into account different weighted coefficients.

It is planned to develop a method capable of having an effective impact on increasing the investment attractiveness of the field of construction in progress based on the coordination of the interests of stakeholders - government, population and business.

4. References

[1] DBN V.1.2-14-2009. Zahalni pryntsypy zabezpechennia nadiinosti ta konstruktyvnoi bezpeky budivel, sporud, budivelnykh konstruktsii [General principles of maintenance of reliability and constructive safety of buildings, structures, building constructions]. – K.: Minrehionbud Ukrainy, 2009 – 37p.

[2] Lukianova T.V., Sherbina L.V. Priority formation of criteria of evaluation and selection optimum option of renovation of unfinished project. Modern movement of science: theses of additional. V International Scientific and Practical Internet Conference, February 7-8, 2019 - Dnipro, 2019. - 864 p.

[3] Thomas J., Mullaly M. Understanding the Value of Project Management: First Steps on an International Investigation is Search of Value, Project Management Journal, Vol. 38. No. 3. pp 74-89, DOI: 10.1002/pm. 2007

[4] Gloria O. Oliomogbe, Nigel J. Smith. Value in Megaprojects; Organization, Technology and Management in Construction; Vol 4 (3) 2012, pp 617-624, DOI: 10.5592/otmcj2012.3.5. 2012

[5] Nikishina O.V. Criteria which define effectiveness of investment into the objects of unfinished building/ News of universities. Investments. Building. Real Estate № 5 (10) 2014 – 48-50p.

[6] Express issue of 20.04.2015, №830 the Main Statistical Office in Zaporizhzhya region

[7] Davidenko O.A. Prediction for assets under construction for ri-voltage estate economy // Scientific - technical collection.(14). - 188-190p. 1998

[8] Zhikharev K.L. Investment activity in real estate market: problems of increasing the efficiency of management and organization. M.:Munitsipalnyiy mir [Municipal world],2006 – 133p.

ADVANCING ORGANIZATIONAL CULTURE OF PROJECT MANAGEMENT

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Abstract: *There are many factors, which influence to a project's success. Communication is one of them. The level and organization skills of communication both within the team and with stakeholders is one of these factors. The ability to communicate is based not only on the knowledge of psychology and communication. Effectiveness and quality of communication can be influenced by personal characteristics that are inherent not only to individual, but also to the nation as a whole. That is, we will talk about cultural influence, or the influence of culture. Culture as a separate factor that affects the quality of the communication process studied not enough. However, it has a significant impact, which is reflected both in relation to the project, in relation to the formation of values, the choice of management strategies and methods, attitude to risks, etc. The article presents the results of the literature review, regarding the influence of culture on the projects and programs implementation.*

Keywords: project management, organizational culture, national culture, communication

1. Introduction

The globalization is the base of the economic processes taking place in society today. The process of globalization that exists at present in society obviously had an impact to the processes of project and program management. The transnational corporation's creation, the implementation of large-scale projects and programs in the scientific, economic, educational, social spheres with the involvement of specialists from different countries use explicit or implicit project approaches.

There are many methodologies, methods, and approaches to project management (PMBoK, PRINCE, Agile, Scrum, etc.). Their aim is standardization of certain areas of knowledge on project management, in order to provide a more manageable approach during the projects and programs implementation. Certain areas of knowledge are easily standardized. However, there are those that are more advisory from the point of view of manageability. Communication Management and Stakeholders Management are among them.

Communication management processes and effective collaboration within projects and programs may face certain resistance. One of these obstacles is the uncertainty of the team (team members) in certain phases of the Drexler/Sibbet Team Performance Model [1].

The diversity of cultures, as one of the consequences of globalization, is another obstacle. This obstacle is in the focus of the study. The diversity of cultures is reflected, first, in the wide involvement of specialists from different countries in the management of projects or programs. Each country brings its cultural diversity into the project process, which can be reflected both in the interpretation of well-known project approaches and the creation and use of "own" ones.

The article is devoted to the results of the literature review concerning the impact of culture on the projects and programs implementation.

2. The "culture" in the context of the project management

Culture (from the Latin word "cultura", that, firstly, was defined as cultivation, and later was defined as upbringing, education, development, worship) is a concept that has a large number of

meanings in various fields of human activity [2].

Culture is a complex system of being. In the 20th century, the researchers A. Kroeber and C. Clucichohn made an attempt to combine the achievements of culturologists around the world, and 180 definitions of the concept "culture" were presented in their work "Culture: A Critical Review of Concepts and Definitions". Several hundred definitions of this concept were presented at the XVII World Congress in Toronto, devoted to the problem of "Philosophy and Culture," in 1983 [2].

There is quite a lot of research in the field of culture and intercultural relations within the framework of projects and programs.

According to the ICB 4.0 [3] and IPMA OCB [4] the concept "culture" is defined as "Set of shared views, values, or beliefs guiding people consciously or unconsciously through their actions".

Alas and Tuulik [5; 6] meant by the term "culture" the exchange of history, judgments, ideology, traditions, and language. An approach to the study of intercultural relations states that the culture, especially national culture, is collective programming, the software of the mind. This implies the way people feel, think, act and study through life. Management is carried out by people who bring own values and judgments, and therefore, they have influence to the culture.

National culture is viewed in a broader sense in [7]. It includes what is distributed within the nation, such as spoken language, general political, legal and educational systems. The author suggests using the term "national context" because the existing studies from the national cultures have tend either to free up the context or minimize part of the context that is important for managerial research.

The literature review on national culture study and management showed the presence of three main directions:

1. The first direction of research indicates that management has nothing common with national culture. National culture is guided by objective practice and independent subjects [8]. This "universal" flow is criticized because it cannot determine the difference between universal and dominant forms of management;

2. Psychology was the background for the second direction of studies. Intercultural studies measure countries by characteristics: Individualism, Power Distance, Uncertainty Avoidance or Masculinity [9; 10]. Intercultural studies are based on the assumption that characteristics are general at their character and that national cultures can be compared. These characteristics reflect the position of the participants and not their environment. Intercultural studies were criticized for certain theoretical and methodological distortions [11 - 13]. "They remain very popular among international managers even though they are badly equipped to provide relevant information on national contexts" [7];

3. The third direction of study is often called empical (as opposed to ethical, which is included in intercultural studies). It argues that culture is characterized by its uniqueness and, consequently, there are no common characteristics and there are no possible identical comparisons between cultures [13]. This direction has great potential for management research and has already accumulated significant results. However, it has two significant problems:
   - There are no tools or indicators developed to unite independent case studies;
   - Focusing on culture in the context of meaning, the culture in the context of action is being lost [14]. Culture also influences on practice as an aspect that is important in management.

Intercultural studies have a free context and are almost entirely focused on the context of interpretation. Culture has not only meaning context but also the action context that is why management processes deserve more attention. The starting point for these studies [7] suggests focusing on the analysis of the wording between the meaning context and the action context and carrying on a discussion between actions and the interpretation of these actions. This is important because:
   - The management depends on the action, not on its interpretation. The practice implementation is essentially driven action;

- Actions and considerations of action are not directly related. Brunsson [5] uses the word "hypocrisy" to reflect the relationship between thoughts, decisions, and actions;
- It is possible that the way of combining thoughts and actions is culture-dependent. This hypothesis is open to a detailed study.

Interesting results of the study of cultural influence during the certification of project managers presented in [16]. The authors said that culture has an impact not only to the process of a project or program implementation but also to the process of certification, more precisely, it influences to the need to obtain a project manager certificate by specialists. The study focus was on the impact of a particular culture (Mediterranean countries: Croatia, Italy, Portugal, and Spain) on certification. However, carrying out the study, the authors, using the open data of the IPMA Certification Validation Management Board, presented an interesting result of the cultural impact on the certification approach, which is given below in Table 1.

Table 1 Percent of certification according to ICB in clusters [16]

The title of the cluster	Country	% of certification according to ICB	Total (%)
German Europe	Austria	6,2	34,01
	Germany	17,44	
	The Netherlands	4,90	
	Switzerland	5,47	
Northern Europe	Denmark	2,83	6,67
	Finland	2,25	
	Sweden	1,59	
English Area	Ireland	1,38	25,02
	The Great Britain	23,64	
Latin Europe	Croatia	0,30	2,93
	France	1,12	
	Italy	0,47	
	Portugal	0,70	
	Spain	0,34	
Eastern Europe	Hungary	0,045	0,0844
	Russia	0,012	
	Kazakhstan	0,004	
	Slovenia	0,002	
	Poland	0,021	
	Greece	0,0004	

Countries are divided by areas that do not always correspond to the generally accepted division. The division was carried out based on similar characteristics of national cultures.

In the period of globalization, it is very important and significant taking into account the multiculturality during the project and program implementation [17]. It is so important that the concept of "Harmony in Global Project Management" had been presented in 2014 at the Expert Seminar of the International Project Management Association (IPMA) [18]. The concept highlights three equal main factors that have an impact on global project management: industry, people and culture.

The approach assumes that the harmoniously co-operation with the simultaneous integration of various professional, intellectual and cultural factors can be in global projects management. Cultural management should be included in the set of global project management tools. The advantage will be not only better Stakeholders Management, but also good communication functioning. Cultural management ease Resource Management, as well as Project Process and Implementation [17].

The authors [17] argue there are many factors for the successful project implementation. The qualified project manager is one of them. He/she can simultaneously deal with three factors of influence: work, people and culture. The true causes of many conflicts in multinational co-operation have long roots and the start may be a minor cultural misunderstanding or personal disinterest.

Hofstede [19] in his studies is underlining the link between theories and practices of management and the concept of culture "a management technique or philosophy that is appropriate in one national culture is not necessarily appropriate in another".

Since people, who are strongly influenced by their values and beliefs, carry out management there is no management activity that would be "without culture." Approximately 18,000 middle managers from 62 countries were compared in the framework of the GLOBE project [20]. The results show that culture is tied to behavior in organizations and management peculiarities. Muller and Turner [21] presented an empirical study that addressed the study of Communication Management as one of the knowledge field (according to PMI PMBoK). It is one of the most important influence on the project results from all fields of knowledge (PMI) (measured in the indicators of the earned value technique). This study revealed the influence of Hofstede's cultural dimensions on the communication benefits between project owners and project managers. "Differences in national cultures require differences in management practices" [22], and can create serious obstacles to the project management implementation.

The influence of national culture on the project management implementation was indicated in [19] as the study's results that was provided on the example of 74 countries.

3. Results and Conclusion

The literary review has shown that culture can significantly influence the management processes. The impact of different cultures on the project and program implementation is still an interesting question. According to the IPMA OCB [4] "Acknowledging the different cultures in an organization and encouraging communication about the differences will help to develop cultural awareness and to align permanent and temporary parts of the organization as well achieving better cooperation with external partners". On the other hands, The IPMA OCB [4] said about culture from the position of the organization "Organizations are social systems, where personal behavior is affected by values, visions, norms, symbols, beliefs and ethics, which constitute a specific organizational culture. PP&P are also performed within a specific cultural context influencing the behavior of people acting in PP&P. Normally each project, programme and portfolio will develop its own culture over time. Potentially this can lead to difficulties with communication and misunderstandings. Therefore, the organization needs to work to ensure the alignment of PP&P cultures with the cultures of related internal and external parties".

However, we offer to study influence of culture as an influence of the national culture on the organizational culture during the project and program implementation.

Certain questions for future study are formulated as follows: In which areas of knowledge such influence is most significant and where it is minor? Does the cultural aspect affect the risks and selection of projects? Does culture impact on choice and application of managerial approaches? How does the manager's culture affect the selection of the project team?

In addition, in terms of future research, the interconnection and the influence of culture and mentality in terms of the project's mental space formation and development can be considered.

According to the literature review, the culture has an influence on management. The learning the culture influence should be included in the curriculum for project management. First of all, it should be check the existing learning programs with regard to that and add learning of the cultural influence, if it is absent. Unfortunately, the first universities that are needed to add the cultural aspect in curriculums are the Ukrainian universities especially in the context European integration of the country and opening of the studies boundaries for foreign students.

4. References

[1] M. Krogerus & R. Chappeler: 50 models of the strategically thinking. Olymp-business, pp. 100, (2012)

[2] Culture: https://ua.wikipedia.org/wiki/, last visited on April 29, (2019)

[3] IPMA Global Standards: Individual Competence Baseline for Project, Programme & Portfolio Management, Version 4.0, International Project Management Association, vol. 1, p. 17, (2015)

[4] IPMA OCB: IPMA Organizational Competence Baseline – The standard for moving organizations forward, International Project Management Association, p. 11, (2013)

[5] R. Alas & K. Tuulik: Cultural practices and values at the societal level in Estonia in comparison with neighbouring countries. Journal Business of Economic Management, # 8(1), P. 39–44, (2007)

[6] J. S. Rodrigues, A.R Costa & C.G. Gestoso: Project planning and control: Does national culture influence project success? Procedia Technology, # 16, P. 1047 – 1056, (2014)

[7] J. de Bony: Project management and national culture: A Dutch–French case study. International Journal of Project Management, # 28, P. 173–182, (2010)

[8] T.J. Peters & R.H. Waterman: In Search of Excellence, Harper & Row, pp. 245, (1982)

[9] G. Hofstede: Culture's Consequences, second ed., Thousand Oaks, pp. 157, (2001)

[10] G. Hofstede: Cultures and Organizations: Software of the Mind, McGraw-Hill, pp. 315, (1991)

[11] J.W. Berry, Y.H Poortinga, M.H. Segall & P.R. Dasen: Cross-Cultural Psychology, second ed., Cambridge University Press, pp. 417, (2002)

[12] U. Kim, H.C. Triandis, C. Kagitcibasi, S. Choi & G. Yoon: Individualism and Collectivism, Theory, Methods and Applications, Cross-Cultural Research and Methodology Series, Vol. 18, P. 32-45, (1994)

[13] M. Chapman: Social anthropology, business studies and cultural issues, International Studies of Management and Organization, # 26 (4), P. 3–29, (1996)

[14] E. Friedberg: La culture nationale n'est pas le tout social, Revue Franc_aise de Sociologie, # 46 (1), P. 177–193, (2005)

[15] N. Brunsson: The Organization of Hypocrisy, Talk Decisions and Actions in Organizations, Abstract, Liber, 1 p., (2002)

[16] R.D. Vlahov, S. Mišić & M. Radujkovića: The influence of cultural diversity on project management competence development – the Mediterranean experience, Procedia - Social and Behavioral Sciences, # 226, P. 463 – 469, (2016)

[17] J. Huang: The challenge of multicultural management in global projects, Procedia - Social and Behavioral Sciences, # 226, P. 75 – 81, (2016)

[18] J. Huang & A. Chung: Optimaization of global project management and the required tools, In: IPMA Experts Seminar 2014: „Future trend in project, programme and portfolio management 2014", P. 152-170, (2014)

[19] C. Bredillet, F. Yatim & P. Ruiz: Project management deployment: The role of cultural factors, International Journal of Project Management, # 28, P. 183–193, (2010)

[20] R.J. House, P.J. Hanges, Q. Ruiz & S. Antonio: Cultural Influences on Leadership and Organizations: Project GLOBE ed., Project GLOBE: Report, 40 P., (1997)

[21] R. Muller & J.R. Turner: Cultural Differences in Project Owner – Project Manager Communication, In: PMI Research Conference, ed. Project Management Institute, Conference Proceedings, London, UK, (2004)

[22] K.L. Newman & S.D. Nollen: Culture and congruence: the fit between management practices and national culture, Journal of International Business Studies, # 27 (4), P. 753, (1996)

RESOURCES MANAGEMENT OF PROJECTS PORTFOLIO IN 4P-ENVIRONMENT

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***Abstract:** Resources management of projects portfolio demanded different approach for getting and using purchased and produced resources of project-oriented enterprises. Especially this is actually when project-oriented enterprise produces resources for its project and operating activities. So, there is a need to create such models, methods and tools that allow to carry out resource management for all activities of project-oriented enterprise (like projects portfolio, programs, project and production) in the same time. This will provide increasing of projects portfolio effectiveness of project-oriented enterprise.*

Keywords: projects portfolio, resources management, project-oriented enterprises.

1. Introduction

One of the problems of modern project management is that usually in enterprises various software tools are used to solve various project management functional tasks: planning, control, economic and financial evaluation, etc. Traditionally, the tasks of information integration in such systems are considered in the framework of managing information communication in projects. But with the increase in the level of informatization of project-oriented enterprises, the use of it to solve the functional problems of various information systems is not enough. This task is even more complicated when it is required to manage large-scale programs or portfolio projects and programs. There are new problems - coordination of activities, allocation of resources, prioritization of projects and programs, formation of teams, performance of industrial or managerial functions of the enterprise not in the context of individual projects, but on the portfolio as a whole. And then there is another level of difficulty.

Tasks of projects and programs portfolio management intersect with the functional tasks of management by the enterprise. Proceeding from this, the task of creating a unified functional environment for managing projects, programs, project and program portfolios and a project-oriented enterprise (4P-environment), which would include tools involved both in the project and operational activities of the enterprise. The 4P-environment will be providing a systemic (synergistic) effect from solving a set of tasks of managing of projects and programs portfolios as a single system of functions.

Modern management methodologies, in particular, project management methodologies, enable project-oriented enterprises to solve complex development problems in conditions of fierce competition, limited resources and time. And the key issue in their work is how to properly manage resources in project portfolios. Therefore, it is very important to find in these conditions a scientific solution to the problem of resource management in the 4P-environment of the enterprise.

The main aim of the article is creating of resources classification according to its type, structure and methods of obtaining, because for different classes of resources can be applied different

management approaches. It's the first step for developing of resources management models in 4P-environment of project – oriented enterprise.

2. Analysis of the latest research and publications

The concept of the resource in the project is quite extensive, and it includes work, financial and logistical resources, project team, information, knowledge and technology. Since the resource is all that the project has, the timing, budget, quality of the project implementation and its product depend largely on the efficiency of resource management. When resources are producing inside the project boundaries, resources management includes processes of planning, production and procurement, supply, distribution, accounting and control of resources.

Today, many studies are devoted to the distribution of resources for portfolio projects [1-6]. Nevertheless, to date there are few works that would be devoted to problems of project planning with limited resources. Most of them are based on prioritization rules. Extensions for a multi-project environment are achieved through the fact that projects are considered independent and linked only through limited resources. The target function in the models of such tasks includes the indicators of each of the projects (as a rule, a convolution of the criteria based on the use of weight coefficients). At the same time, in the limitations there are dependencies that reflect the logical connection between project works. The logical relationships between portfolio projects are reflected in the models by introducing fictitious start and finish operations [6-8].

3. The Primary Research Materials

Definition 1. A functional 4P-environment (or simply 4P-environment) is a systematic set of functions of project, programs, project and program portfolios, and a project-oriented enterprise management (in terms of management of project, programs, and portfolios) that use a single information resource and provide a systemic (synergetic) effect from solving a set of tasks of management of project-oriented businesses of enterprises and organizations.

Before moving on to building a resource management model in the 4P-environment, consider the features of project resource management. The article considers the management of material and technical resources of the 4P-environment.

Definition 2. Resource of 4P-environment (hereinafter - R4P) - material object of 4P-environment, obtained as a result of production activities of the enterprise or as a result of procurement.

As experience shows, usually the material resources are characterized by parameters such as: name of the resource, type, cost, unit of measurement, volume, customer, supplier, etc. These methodologies cover all the characteristics of the resource required for its use in the project, but they do not take into account the situation when a resource changes its state in the process of project implementation or is created at the production of a project-oriented enterprise, or the resource of one project is an integral part of the resource of another project.

Depending on the type, state, structure and method of obtaining a resource, it is necessary to classify the resource management models in the 4P-environment by the following features:
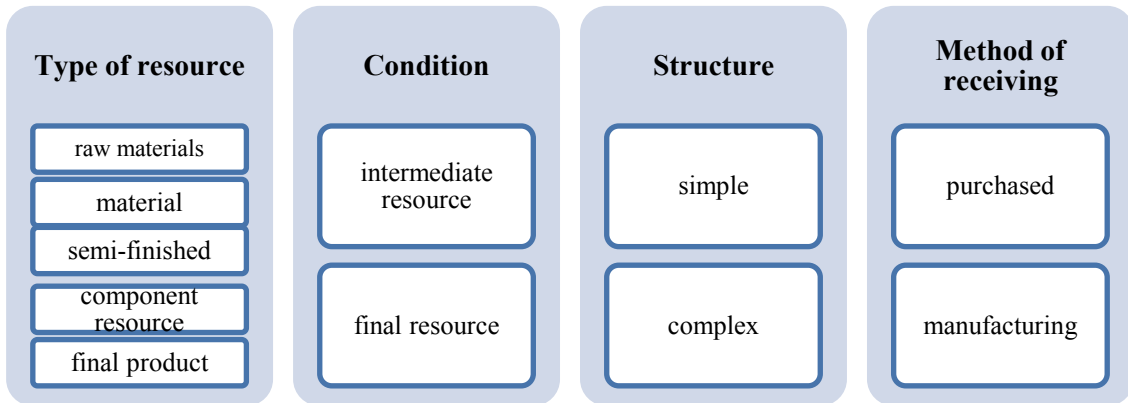
Figure 1. 4P-environment resource modules

The above signs form a plurality of resource classes of the 4P-environment. Thus, we can allocate classes of resources according to the proposed classification.

The same tools of the 4P-environment can be applied to different resource classes. Then, these resources can be grouped into classes, called the **4P-environment resource module**. The resource module is created in accordance with the process of using resources in projects, programs, portfolios and project-oriented activities of the enterprise. Based on the experience of resource management in the project and production activities of the enterprise, the following resource modules are allocated:

1. **Produced raw materials**: raw / semi-finished, intermediate, simple, manufacturing.
2. **Purchased raw materials**: raw / semi-finished, intermediate, simple, purchased.
3. **Component produced resource**: component product, intermediate, complex, manufacturing.
4. **Component purchased resource**: component product, intermediate, simple, purchased.
5. **The final produced resource**: finished product, final, complex, manufacturing.
6. **The final purchased resource**: finished product, final, simple, purchased.

Figure 2 shows the scheme of the interconnection of 4P-environment resource modules.
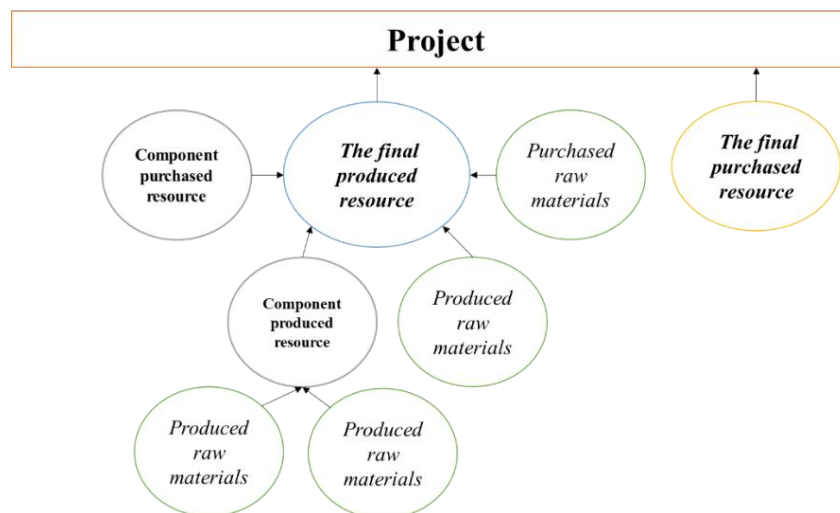

Figure 2. Scheme of interconnection of resource modules

In the general case, during the management of resources in the 4P-environment, a plurality of processes of resources planning, procurement, production, storage, logistics, etc. is implemented. And the result of the management process is the final resource that is used in the project. During its production, the projects use and create a variety of different resources, which are products of the production activities of the project-oriented enterprise. Each resource can have three states:

raw material, component resource and ready resource. And resources can be obtained either through production or through purchases. Proceeding from this, it is proposed to implement in 4P-environment different models of management for the produced resources in the process of production activities of the enterprise, and for the purchase of final resources. Management model for the produced resources in the process of production activities of the enterprise should be considered in the context of the integration of project and production activities in further research.

4. Results and Conclusion

In the article proposed classification of projects portfolio resources in project-oriented enterprises. The classification allowed distinguish modules for which is possible to use typical models and methods of management. The models and methods used for project's plan creating and implementation of execution control. The planning processes are determined time moments of beginning and completing of processes resources getting.
The subject of future researches is creating of models, methods and tools of produced resources management, when produced resource of the project is part of the resources of other projects.

5. References

[1] S. Li, L.B. Tang, Application of multi-project management in scientific research projects, Journal of Anhui Vocational College of Electronics&Information Technology, 9, pp. 26-27 (2010)

[2] Li, X.B. & Nie, M & Yang, G.H. & Wang, X. The Study of Multi-Project Resource Management Method Suitable for Research Institutes from Application Perspective. Procedia Engineering, 174, pp.155-160 (2017)

[3] Pinha, D.C. & Ahluwalia, R.S. J Flexible resource management and its effect on project cost and duration. Journal of Industrial Engineering International. Vol 15 (1), pp 119–133 (2019).

[4] Pinha D Short-term resource allocation and management. Ph.D. dissertation, West Virginia University, USA (2015)

[5] Jain M, Mittal RJ Adaptive call admission control and resource allocation in multi server wireless/cellular network. Journal of Industrial Engineering International. Vol.12(1), pp 71–80 (2016).

[6] Anshin V., Demkin I., Nikonov I., Carkov I.: Models of project portfolio management in uncertainty conditions. Publishing House MATI (2007)

[7] Nozick Linda K., Turnquist Mark A., Ningxiong Xu: Managing Portfolios of Projects under Uncertainty. Annals of Operations Research, №132, pp. 243–256 (2004)

[8] Karlinska E.& Katansky V.: Opus Magnum Enterprise Management. Semi-functional solution for business and organization management (2006).

IMPORTANT PRINCIPLES TO BE TAKEN INTO ACCOUNT DURING STEP BY STEP BUSINESS PROCESS AUTOMATION

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Abstract: *Developing the list of principles creates opportunity to minimize mistakes of project of reengineering corporation. The aim is to deal with recommendations and ideas for setting up such a strategy of business process automation in a company which is especially useful if the project is planned to be long-term and gradual. Despite the evolution of BPM implementation, the main stages should be planned in the project. Repeatable actions, circulation of documentation, integration of different software, workflows of general processes that could vanish tomorrow and using AI in the nearest future are things that contain margin to save time and reduce project budget and risks.*

Keywords: business processes automation, business processes automation system, business process management.

1. Introduction

Today, the project of business processes automation usually is high budget for general organizations. On the other hand, consultant services are expansive. Because of this lots of companies decide to model and automate processes step by step or department by department. Considering changeable conditions results can be different. After years of implementation it may turn out that the entire budget went to optimize one process, which did not bring profit in cooperation with other processes of other departments of the company. We are going to descry what principles are important in such case. There are lots of different questions like whom is going to be a manger of implementation – external consultant or internal specialist. Icebergs could exist in both variants. For example, first variant is dangerous because the distinction of acquaintance with specific technology field and should be rather high-quality professional team, consists of numerous specialists. Second – is not guaranteeing system approach in which existing standards and techniques can be missed. This problem can be solved using systematization of general pitfalls are observed in the same projects. Article's purpose is to deal with recommendations and ideas for setting up such a strategy of business process automation in a company which is especially useful if the project is planned to be long-term and gradual

2. Bearing pillars of business process management (BPM)

Evaluating from reengineering of business processes times through lean management and other methods of increasing enterprise potential nowadays we can observe BPM (Business Process Management) era which is overtaking with the forthcoming approaches.
Traditional BPM include highly integrated software tools to address many resources that could be managed by a process (people, systems, services, integrations, data, events, goals, rules, tolerances, work lists, dashboards etc.). A process life cycle from Gartner became quite ubiquitous: define, design, analyze, simulate, implement, execute, monitor, and optimize [4].
Modern software is not working autonomous, but only developed BPM creates acceptable environment for implementing improvements in organization, which is mention in different works [3] [1]. Nevertheless it is rarely seen that company gradually start from process defining.

Usually executives or managers see week spot and try to solve it pointwise through affordable computer-aided systems. There is big choice of business applications that does not usually cover immediately all requirements of company, so that there is question to code software specifically for the company or use it with other software, which is already bought.

Firstly, it is important to make the process wright before automating it. Great deal of improvements can be achieved even without implementation of technology [1]. But before this it is much more valuable to choose write process. It is failure to choose those one which should be completely removed or 'injured' [5].

BPM Systems could mean automation of business processes through integration of directory, CRM, ERP, Database using collaboration with partners, exchanging and hubs and reporting with BI tools.

3. Important aspects of 'step by step' business process automation

Lots of authors are emphasizing of the importance of a comprehensive BPA (Business Processes Automation) implementation [2]. Despite of it low-budget projects usually become long-term and don't cover whole company at first stages. It possible could be division by main processes, for example, managing processes or division by departments. Division is dependent on context. For agile company it is not a problem to change one process, for ossified structures start working with departments could be more effective. Technologies and methodologies are developing extremely fast, so it is obvious that a project requirements are going to change. These are aspects that can help keeping abreast.

•   Eliminating repeatable actions through departments should be decided as a first goal. Excluding of duplicating tasks is one of the benefits of BPM [3], but if you are working with one department or one process for long period it is wisely to analyze other repeatable actions in company and work with them immediately. It can increase costs in times instead of minimizing. For example, if there is not structured directory it can be duplicated in every department in necessary size introduced by documents and emails on computers. Different managers can have their own contractors' contacts base, which is repeated in financial department as payees and in production department as members of some processes etc. In this case if information about some part of contracts is already data structured and automized it is logical to try share this little victory with other colleges to make it more profitable, in some cases non-detrimental.

•   Circulation of documentation should be minimized with BI techniques. Huge circulation of numerous documentation is a part of every company and most of processes nowadays. But the nearest future is going to change it. Considering nowadays affordable solutions circulation will be fixed as a process and automized with CRM or ERP and the documentation will produce information that become an input of cloud-based report. Logically, we need to consider it if we have half-automized "processes". For example, if you have a kind of data base, but still send your spreadsheets by emails, it is wisely to think about cloud-based solution with approval workflow.

•   Planning integration of different software which is already used and going to be used Most of well-known services we are using now is already almost synchronized within our digests but not everywhere they are synchronized in write way in companies. All activities that we used to do during the work can be a process input instead of scribble of paper: - Mailing
-   Planning
-   Chatting
-   Using social networks
-   Saving files
-   Calendar
-   Notes
-   WBS designing
-   RBS designing
-   Contracts

- Directory documenting
- Purchases documenting
- Payment scheduling
- Resources managing

It can be taken into account in different manners. Important is to have strict templates for these actions, especially where they are a part of process that is already defining, designing and automating. Software environment that was chosen for every action influence also. Every document and email can be used for data base filling which is already minimize manual data filling. It is difficult to rebuild these "events" in whole company immediately because most of them are human-oriented processes, but it is not a cause to ignore this opportunity in step by step automation.

• Easiest workflows of general processes that could be done tomorrow

Lots of processes that workers should do every day can already be automized even if they have not been done ready in your company. Among them are sending emails, making phone calls and getting approvals etc. Considering this "incapable" procedures should not take much time and effort to improve, because in nearest future most of elements are going to disappear. For sure, data base rules are important to remember to make workflows possible to create.

• Considering using AI in the nearest future

Artificial Intelligence solutions are expansive for most companies at present times, almost because of their development cost. Nevertheless, some services are already proposed them. Every BPM strategy should include perspective using AI for integration different services and application through smartphone. These functions are already produced by bots.

4. Results and Conclusion

The considerations explained in this contribution can help managers of Business Process Automation project do not get lost in rules of management and technology requirements that can change during the time. But collect experiences and knowledge about future and predict bottlenecks and do not lose profitability. Processes should be defined, designed, analyzed, simulated, implemented, executed, monitored and optimized. Eliminating repeatable actions, minimizing of circulation of documentation, planning integration of different software which is already used, paying attention on unnecessary vanishing processes and predicting using AI technology can help to avoid potential problems in project and eliminate risks.

5. References

[1] J. Jeston, J.Nelis. Business Process Management: Practical Guidelines to Successful Implementations. 1st Edition, Elsevier Ltd. (2006)

[2] F.W.Breyfogle III. The Business Process Management Guidebook: An Integrated Enterprise Excellence BPM System. Citrus Publishing Inc. (2013)

[3] T. Panagacos. The Ultimate Guide to Business Process Management: Everything you need to know and how to apply it to your organization. 8/26/12 edition, CreateSpace Independent Publishing Platform (2012)

[4] J. Sinur, J.Odell. Business Process Management: The Next Wave. 1-st edition, MeghanKiffer Press (2013)

[5] F. Gerhardsson, E. Åkerlund. Process Automation with Business Process Management. Stockholm, Lund University (2012)

EXPLORING THE INTEGRATION OF LORA AND WI-FI TECHNOLOGIES FOR SMART GRID APPLICATIONS

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Abstract: *The advancement in communication technologies has been very fast in the last century. This made people start thinking of concepts such as the Internet of Things (IoT), Smart home and Smart grid. LoRa (Long Range) is a communication technology that makes it possible to send data over long distances. On the other side, Wi-Fi is designed mainly for indoor communication. In this work, we will explore the potential of integrating these two technologies to build a relatively cheap network to enable some smart grid applications. The main goal is to enable households to build their own smart home and at the same time give utility companies a method to build some smart grid applications such as smart metering and direct load control. We will build a system that enables households to control some devices remotely using Wi-Fi technology. Additionally, we will explore the possibility to send data over long distances using LoRa. The chip ESP8266 (NodeMCU) will be used for indoor communication using Wi-Fi technology and we are going to use a LoRa IoT Development Kit for long distances communication.*

Keywords: LoRa, Smart Grid, Demand Response, Direct Load Control, Smart Metering

1. Introduction

LoRa is a technology developed by Semtech. It is a wireless technology designed specifically for long distances. LoRa stands for long-range radio. LoRa is primarily related to (IoT) and the machine to the machine (M2M) communications. In LoRa networks, nodes send to gateways which are connected to severs. It provides low data rates for long distances (several kilometers). Therefore, LoRa is useful to send low data rates over large distances without routing over multi-hop. Each LoRa gateway can handle a large number of nodes. LoRa networks are infrastructure-less and hence they can build cheap networks. LoRa provide an adaptive data rate to improve battery life and network capacity [1][2]. Wi-Fi is a wireless technology that is used mainly for indoor communication. It enables nodes, e.g. computers, to send and receive data inside and outside buildings with a high data rate. It is possible to provide access service at the level of buildings such as a whole airport or an enterprise building or even a city by increasing the number of access points. Smart Grid represents the future power grid. Smart Grid exploits information and communication technologies to improve the performance of the electricity networks. This enables new applications such as optimized Volt/VAR control, demand response and smart metering. Direct Load Control can be used to reduce the demand at high demand periods. It is a method to remotely control a device. This approach allows utility companies to control household appliances inside and outside peak times. It regulates the amount of energy that can be consumed by the load, in order to reduce the client's demand for energy at certain times. Smart meter records consumption of electricity at a specified time (every hour or every half hour). The meter keeps these measurements on a built-in memory and then sends it to the electricity company. This helps to monitor the consumption pattern. Unlike traditional meters, smart meters can be used to send two-way information between the costumer and the electricity company.

2. System Architecture and a Prototype

Fig. 1 illustrates the system architecture. Each house is equipped by a home-gateway which enables the communication between the utility company and the household. This way, the utility

company can communicate with the household using LoRa. For instance, it can control house appliances to apply direct load control or read the smart meter remotely. Additionally, it can send the consumer data such as day-ahead price to encourage the costumer to shift part of the load from the high demand period to low demand period. The user can use this architecture to build his smart home. He can control the appliances using smartphone or laptop.
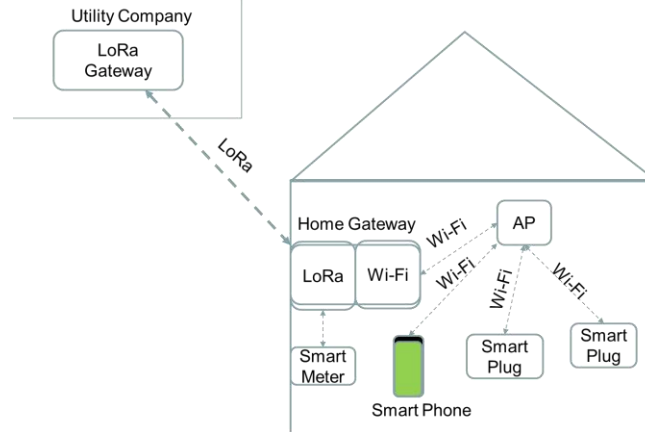

Figure 1. System Architecture

As a proof of concept we build a system using NodeMCU, LoRa gateway, and LoRa node (Fig. 2). We tested direct load control where we sent commands using LoRa gateway to control household appliances connected using a Relay. In our initial evaluation inside the university, packets from the gateway were delivered with a reliability of 90%.
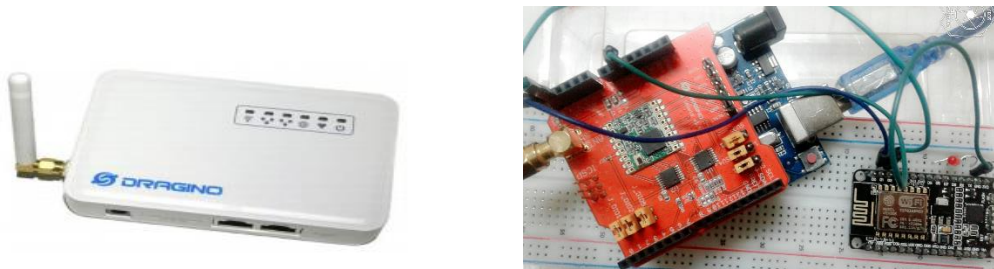
Figure 2. LoRa Gateway, LoRa node and NodeMCU.

3. Conclusion and Discussion

In this work, we presented a system that uses LoRa and WiFi technologies to build some smart grid applications such as direct load control and smart metering. On the same time, the system can be used to build smart home. Compared to other solutions, our approach allows the utility companies to build their own private network in which they have full control. Additionally the system is cost-effective.

4. References

[1] A. Augustin, J. Yi, T. Clausen, and W. M. Townsley, "A Study of LoRa: Long Range & Low Power Networks for the Internet of Things," Sensors, vol. 16, no. 9, p. 1466, 2016.
[2] Martin Bor, John Vidler, and Utz Roedig. 2016. LoRa for the Internet of Things. In Proceedings of the 2016 International Conference on Embedded Wireless Systems and Networks (EWSN '16). Junction Publishing, USA, 361-366.
[3] Lars T. Berger, Krzysztof Iniewski, Smart Grid Applications, Communications, and Security Wiley, 2012.

RISC-V PROCESSOR WITH CONFIGURABLE PIPELINE STAGE PLACEMENT

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Abstract: *Many different hardware implementations around the RISC-V instruction set have gained attention, among many other things, they differ in pipeline design with different structures, but few studies compare those differences and the impact of the decisions taken on the final design. This paper discusses a proposed microarchitecture supporting the base RISC-V instruction set, including a pipeline with configurable stages. This could then be a basis for further pipeline design space explorations taking account of area, speed, implementation complexity and power consumption. The presented work aims to investigate the behavior of non-pipelined and pipelined implementations what can be beneficial when making a design decision for a specific embedded domain. Systems with custom requirements such as required chip area, energy efficiency would benefit from using configurable pipeline architecture. The paper describes the authors view on implementing such a core and shows up some application examples.*

Keywords: RISC-V, microarchitecture, embedded systems

1. Introduction

While historically, very first computers with simple instruction sets did use single-cycle microprocessors, nowadays such kind of microprocessor design is deprecated as inefficient for modern computationally intensive routines, such as those including the floating-point operations and others of respective complexity. The weak spot of the single-cycle, non-pipelined implementations is that the cycle time is limited by the longest path. Therefore, the processor must operate at the speed of the slowest instruction.

Pipelining increases the throughput of the processed instructions at the cost of a higher individual instruction latency. Furthermore, the gained throughput cannot always be maintained. The processor must take appropriate actions for certain workloads, for example where an instruction has a dependency on the result of previous instruction, which is generally called a data hazard. Many methods were developed to deal with various kinds of hazards for example but not limited to operand forwarding, pipeline stalling, and branch prediction. All in all, the efficiency of those methods and therefore also the ideal pipeline length depends on the instruction stream and thus also on the application domain. Wrong design decisions in this area will at least decrease the energy efficiency of the processor and increase the implementation complexity without significant gains.

As a matter of consequence, the complexity of the instructions defined by the instruction set architecture ISA have a direct impact on the achievable clock frequency. The critical path within a hart defines the maximum length of the clock cycle, thus indicating the direct dependency between the complexity of an instruction set and the clock frequency. At least for single-cycle processors of a high variability in computational complexity might lower the energy efficiency.

The RISC-V ISA was designed with modularity in mind and the concept of modular pipeline stages could extend this philosophy giving more space for research and flexibility when making design decision. Thus, this could lead to more balanced tradeoffs between specific requirements set up to a core and its efficiency with respect to chip area and energy consumption.

Answers to questions concerning power consumption, required chip area and timing performance characteristics determine future practicability of anew implemented single-cycle cores and therefore require research to be accomplished. Present article gives a brief overview of concepts targeting implementation of a RISC-V based core with configurable modular pipeline architecture, research activities, and possible examples of applications which would benefit from using processors of such design.

2. Current state in research

The current state of the art demonstrates different technologies and development flows employed to improve power efficiency and chip area size. Thus, [2], as one of the examples, explains the techniques used to develop power balanced pipelines that significantly increase power savings on the whole. The method developed demonstrate different approaches to the problem including design-level power balancing, post-silicon static voltage assignment, and dynamic power balancing. All the methods listed are based on the cycle stealing and voltage level reduction concepts. Analysis of the results comes to the conclusion that the power savings can result up to 46% in processor power reduction.

Paper [2] presents a technique, which is commonly known as voltage-frequency scaling (VFS). Although this technique is effective in reduction of energy consumption and can be accomplished statically and dynamically, it has conceptual limitations due to the fact that threshold voltage scaling will slow down as semiconductor technologies advance. An alternative solution based on architectural approaches to the problem of power efficiency are presented in [4] and [5]. Particularly, [4] has its focus on a method called pipeline stage unification (PSU). PSU dynamically scales the clock rate to reduce energy consumption as with VFS, but unlike VFS, it unifies multiple pipeline stages by bypassing pipeline registers, instead of scaling down the supply voltage. Comparing to VFS, PSU can reduce energy consumption by 14% at 50% frequency reduction. A more sophisticated technique described in [5] and called variable stage pipeline (VSP) allows to improve energy efficiency by 13% compared with PSU. This approach is similar to PSU, but it is elaborated to minimize the number of glitches occurred when pipeline stages are unified, what allows to reduce energy dissipation caused by glitch propagation.

Though pipelined cores are the most probably cores of choice nowadays, literature research has shown that the interest in single-cycle cores is gently kept warm by community, and this type of microarchitecture is mostly used in academia environment for educational purposes or for research activities with respect to specific application domains. Thus, [5] describes RISC load/store non-pipelined processor architecture for signal processing application. The work elaborates incrementer, adder and multiplier circuit design in order to achieve more efficient performance.

Coming to this point, to our best knowledge, there are currently no precise results on comparison of the non-pipelined RISC-V versions against their pipelined counterparts at all other microarchitectural decisions taken being equal.

3. Motivation

Placement of pipeline stages requires deep knowledge of non-pipelined counterpart and particular attention given to its timing characteristics analysis. Paper [6] presents such a methodology in

development of a multiplier with automatic insertion of pipeline stages with respect to specifics of its microarchitecture. Overview of the presented work shows that similar approach can be developed for different microarchitecture taking account of architectural particularities, set of requirements, and constraints.

Pipelined microarchitectures have gained widespread in systems with high throughput where high clock frequencies and count of instructions per second are required. However, the registers used to implement pipeline come at the cost of chip area and energy efficiency. Thus, an over-engineered pipeline can lead to bigger chip area, power consumption and extended latency, whereas a solution with a few pipeline stages will not be enough to achieve required system clock frequency.

Unlike pipelined microarchitectures, non-pipelined, single-cycle cores, solutions are distinguished by a conceptual feature that an instruction is fetched, decoded, executed, data accessed, and the result is written at a destination address in a single-cycle. This imposes restrictions on performance but allows to keep hardware implementation rather simple comparing to more efficient pipelined microarchitectures

The positive and negative aspects of each of the basis underlying the non-pipelined and pipelined microarchitectures give proper motivation and outline research space. This includes development of a non-pipelined, single-cycle, baseline solution, and development of its pipelined counterpart. The baseline configuration is being developed with a concept in mind to carry out the RV32I standard base instruction set in single hart machine mode of operation (M-mode) without cache memory. Such configuration leaves a lot of room for improvements, and itself can serve a baseline design for comparative analysis with more elaborated solutions or to be a subject for further developments and experiments in educational process. As the first step in elaboration of the core, the baseline implementation will be added with pipeline stages on demand, following the philosophy of configurable stage placement, on the critical path of the baseline implementation, which is defined by the "load" instruction.

Next section gives a brief review of the baseline microarchitecture developed within the scope of presented work.

4. Baseline non-pipelined microarchitecture

Proposed microarchitecture adheres development flow and concepts set out in [1], [7], [8]. Fig. 1 depicts simplified top-level structural diagram of the core, and it is composed of six functional blocks including: *Control logic* to perform overall control on the core operating with instructions and the results of operations performed; *Fetch logic* required to extract instructions from memory, and increment program counter correspondingly; *Immediate generator logic* to decode values encoded directly into instructions, the logic produces immediate values in five variants depending on the instruction formats; *CSR register file* representing a set of control and status register used to keep and to set the current state of the core;

Integer register file is another set of registers, in amount of 32, which are used to store operands representing integer values or state of the core; *ALU (arithmetic logic unit)* to conduct arithmetic and logic operations on the operands kept in the integer register file. The data-path of the baseline core shown in is explained as follows.
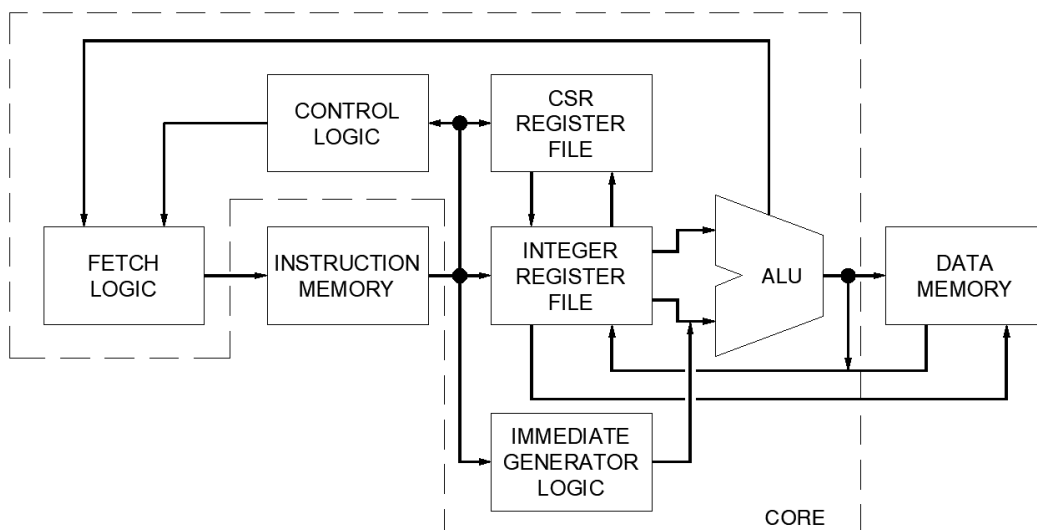
Figure 1. Simplified architecture of baseline non-pipelined core

As the first step, an instruction is fetched from the instruction memory, meaning that the instruction code is set up on the inputs of the CSR and RV32I register files, and also, on the control logic inputs. Fetch logic increments the program counter register value based on the type of instruction being executed. The value is increased by four in case of a sequential instruction, and by an offset in case of B-type or J-type instruction. Switching between the modes to increment the program counter value is managed by control logic.

Depending on instruction type, either CSR or RV32I register file is addressed. In case of CSR register file, exchange of bit patterns between CSR or RV32I register files is performed. The core current state is stored in RV32I register file and updated with a new value. In the latter case, the registers sr1 and sr2 are read from the register file and the corresponding values are fed to ALU.

When an instruction encodes immediate value, the immediate generator logic forms a parameter which is used in further processing instead of the data stored in the sr2 register. At the same time, the control logic decodes current instruction and asserts relevant control signals.

ALU performs an operation on the fed values. Operation is defined by relevant opcode generated by the control logic. The result of operation is set up on the ALU output. The result produced by the ALU is written at a destination address.

Present section briefly outlined proposed architectural decisions and functional relationships for baseline non-pipelined core. The core is minimalistic in its complexity and called upon to serve as reference for further experiments.

5. Configurable pipeline microarchitecture

The stage placement concept is not trivial and transparent for many application domains, it requires deep research of application algorithms and their implementations. This may influence not only hardware implementation, but also hardware synthesis flow and software development component for a particular set of tasks.
As a general guideline, rather than a strict rule, the concept in first approximation can formulated as following:

when penalty cycles contribute more in decreasing energy efficiency than criteria value specified based on trade-off between the performance and power consumption, the pipeline stage placement must be reviewed.

Such formulation implies two possible physical implementation of pipeline stages placement. One approach would be to allocate the stages during compilation of implementation flow based on metrics and second is to utilize physically allocated pipeline stages by means of pipeline configuration.

6. Application domains

We perform hardware-related research in IDiAL (Institute for the Digital Transformation of Application and Living Domains) in the so-called "Chip-Lab". Chip-Lab activities comprise PCB-, FPGA- and digital ASIC-design. Current areas of interest include IoT-devices, low-cost test-systems, autonomous robots and Many-Core-Systems-on-Chip.

Battery-powered and small IoT-devices demand for processing capabilities with a small footprint in terms of power consumption but also in area. Here a non-pipelined RISC-V architecture could provide benefits.

Low-cost test systems for software-intense embedded systems devices perform mainly functional test on the units under test (UUTs). Test systems obviously shall be able to test a greater variety of UUTs of a certain class. Therefore, these test-systems rely on FPGA-technology because of their high flexibility and re-configurability. Functional testing shall take place under hard real-time conditions on multiple stimuli- and measurement-channels in parallel. Linking these channels to multiple co-processors helps to meet the real-time requirements. To achieve a low-cost solution for a test-system, the FPGA as a core component also has to be a low-budget device. Small processor soft-cores, like the non-pipelined RISC-V, become necessary to deal with limited FPGA resources. One special topic to limit cost for functional testing is to avoid physical attachment of sensors and actuators and replace them by means of in-the-loop simulation [9].

We undertake research in cooperation with CITEC at Bielefeld University. The remaining two research areas fall into this cooperation.

Autonomous robots demand a lot of computing power for performing cognitive architectures like neural networks. Mobile robots cannot carry to much load and they cannot provide a lot of electrical energy. Our research focuses on economical ways to provide accelerators for cognitive architectures by means of special purpose processors. Here our RISC-V approach applies.

In the area of Many-Core Systems-on-Chip we regard architectural circumstances for interacting between networks on chip (NoC) and peripheral units. A Many-Core processor chip may consist of an arrangement of hundreds of CPUs interconnected by means of a NoC. To avoid heterogeneity these CPUs should not be involved in managing peripheral access. Instead a limited amount of small-footprint RISC-V processors can act as special purpose "NoC-to-IO" bridging controllers.

7. Follow-up work

Optimal configuration, placement of pipeline stages for specific application domains calls attention for new explorations. This includes the analyses of application specific algorithms and their implementations with respect to instruction streams and penalty cycles from the pipeline hazard overheads. The knowledge obtained will facilitate development of a framework called for efficient allocation of pipeline stages.

8. References

[1] Editors Andrew Waterman and Krste Asanović: The RISC-V Instruction Set Manual, Volume I: User-Level ISA, Document Version 2.2, RISC-V Foundation, May 2017.

[2] John Sartori, Ben Ahrens and Rakesh Kumar: Power Balanced Pipelines, University of Illinois at Urbana-Champaign.

[3] Samiappa Sakthikumaran, S. Salivahanan and V. S. Kanchana Bhaaskaran: 16-Bit RISC Processor Design for Convolution Application, IEEE-International Conference on Recent Trends in Information Technology, ICRTIT 2011, Anna University, Chennai, June 2011.

[4] Hajime Shimada, Hideki Ando, and Toshio Shimada: Pipeline Stage Unification: A Low-Energy Consumption Technique for Future Mobile Processors, proceedings of ISLPED2003, pp.326 -329, 2003.

[5] Tomoyuki Nakabayashi, Takahiro Sasaki, Kazuhiko Ohno and Toshio Kondo: Design and evaluation of variable stages pipeline processor chip, 16th Asia and South Pacific Design Automation Conference (ASP-DAC 2011), 25-28 January 2011.

[6] Creigton Asato, Christoph Ditzen and Suresh Dholakia: A Data-Path Multiplier with Automatic Insertion of Pipeline Stages, IEEE Journal of Solid-state Circuits, Volume 25, April 1990.

[7] Editors Andrew Waterman and Krste Asanović: The RISC-V Instruction Set Manual, Volume II: Privileged Architecture, Version 1.10, RISC-V Foundation, May 2017.

[8] David A. Patterson and John L. Hennessy: Computer Organization and Design RISC-V Edition: The Hardware Software Interface, Morgan Kaufmann Publishers Inc, July 2017.

[9] Igor Khimchenko, Peter Schulz: Trends in modeling and simulation of sensors, International Research Conference (IRC) at the Dortmund University of Applied Sciences, June 29th-30th, 2018, Dortmund, Germany, 2018.

INTERACTIVE EDUCATIONAL ENVIRONMENT FOR KIDS UNIVERSITIES BASED ON RASPBERRY PI

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Abstract: *To attract more students to the engineering studies last years, it becomes more popular to organize kids' universities at the universities, but such activities require confident educational tools. In the paper the authors present the interactive tool for teaching Python for Raspberry Pi for Kids Universities.*

Keywords: Raspberry Pi, Interactive Educational Environment, Smart environment, Kids universities, STEM

1. Introduction

In recent years it became clear in all European countries that there is a lack of engineers, scientists and technicians. The studies leading to this professions got the name STEM-studies (Science, Technology, Engineering and Mathematics), and in all countries promotion of STEM-studies got a lot of attention from governmental and non-governmental companies and associations to provide STEM- education.
Motivating young people by rising their interest in these subjects, is of course a crucial element in attracting later on students in the engineering degrees, to serve companies and economy.
Besides the attention spent on it in regular curricula for (mostly secondary) education, initiatives as kids universities and technology clubs for pupils were established in schools, universities and in private associations (often connected to sponsoring companies) for rising interest in science and technology.
Technical and engineering universities often take a leading role in these initiatives, as they have the technical know-how, expertise and equipment to organize classes and use materials. They have a longtime tradition in teaching these subjects. So, it is a matter of good sense that they provide (teaching) materials on this matter and introduce it to young people. Courses provided in such so-called Kids Universities could be dealing with internet of things, cyber security, advanced robotics, digital engineering, 3D printing and mobile applications [1]. In the National University "Zaporizhzhia Polytechnic" since 2018 there is functioning an initiative called, Kid university "Smart Kids" where kids from 10-16 visit courses on Saturdays or participate in summer camps. Within the summer schools' kids have short introducing modules to technology and it is very important to have flexible educational tools for it.

2. Smart Kids- children's university.

The Smart Kids-children's university initiative at National University "Zaporizhzhia Polytechnic" was set up in 2018 with the aim of motivating youngsters to choose for STEM-related studies.
One of the branches in Smart Kids deals with courses and projects connected to embedded systems and software (development).
This area of technology was chosen for following reasons:

- All nowadays children are attracted to computers.
- Computer tools are readily available at an affordable price.
- Ukraine is a country which has a reputation of offering software development and commercial services to the rest of Europa.

In the Smart Kids an educational platform was built on the basis of the Raspberry Pi-hardware. This platform than is used for different (pupil)projects to teach the children, so that they can explore and use the platform for the realization of their own creative ideas.
In the next sections authors describe the platform and show case studies of the projects.

3. Raspberry Pi as educational platform

One of the most popular of the family of single-board computers is the Raspberry Pi.. Originally, it was designed to encourage children and schools to study programming, but this cheap device became a central unit in projects that nobody dreamed of when it was developed. It contains numerous of integrated tools, such as Scratch, Node-Red [2] and others.
AIn Smart Kids, an interactive tool was created for teaching Python for Raspberry Pi at the summer schools for kids 10-16 years old.

3.1 Interactive environment for Smart Kids

The interactive environment for Smart Kids aims to teach kids to manipulate external devices with the usage of Python.
The architecture of the developed application is very flexible and could be easily expanded for new experiments (Fig. 1).
The developed software has the following functional characteristics/learning goals:
- to get acquainted with theoretical information;
- to add new tasks;
- to see a visual diagram of the connection of the board and sensors;
- to run the testing application for each task;
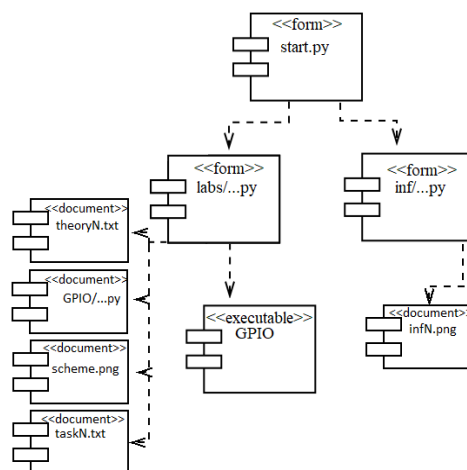- to run developed code directly from the educational environment.

Figure 1. Component Diagram of the application

In the Fig.2 and Fig. 3 you could see the implemented list of tasks, which could be run within the lessons and examples of the teaching material.
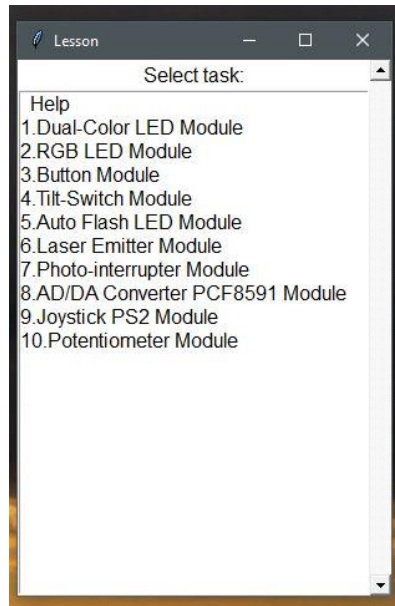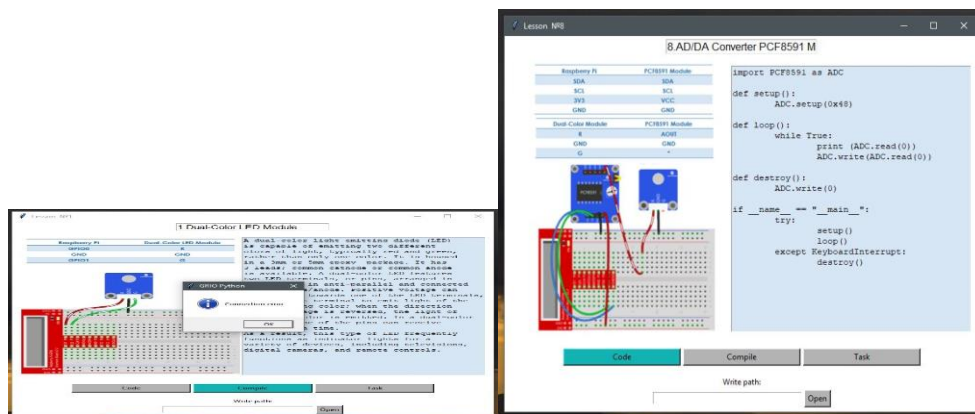
Figure 2. List of experiments

Figure 3. Experiments Examples

Typical positive scenario consists from next steps:

Step 1. Running virtual machine. Starting RPi tutorial.

Step 2. Select the experiment and connect according to the scheme. Connect RPi with experiments to the computer.

Step 3. Select tutorial code and run it under the platform.

Step 4. Got the task to modify the tutorial experiment. Modify the code and run it under the platform.

4. Results and Conclusion

The use of the Raspberry Pi as an educational platform to start teaching kids on programming and connecting sensors and devices with the use of Python is successful. Pupils like the approach and they see immediate impact of their own actions. This is motivating for them and giving a drive to continue to experiment more.

It has a positive influence on their motivation to go for STEM-related subjects at school (and hopefully later on in university).

Further work is to integrate this system with the remote laboratory at Zaporizhzhia National Technical University ISRT (Interactive Smart Remote Technology) and to implement short (knowledge) tests for the kids as part of systematization of the teaching material.

Also small interactive videos will be implemented instead of text to explain the tasks to the children: text is "boring" for them and in a context of motivating for new technologies, a more visual and interactive method with videos can stimulate their attention and creativity.

5. References

[1] P. Arras, G. Tabunshchyk, Managing the multidisciplinary engineering projects in digital transformation era. Conf. proc. Of Dortmund International research conference, (2018), pp. 175-179.

[2] Ph. Degreef, D.Van Merode, G. Tabunshchyk, Low-cost, open-source automation system for education, with node-RED and Raspberry Pi. In book: Smart Industry & Smart Education, (2019), pp. 458-465, DOI: 10.1007/978-3-319-95678-7_51

[3] P. Arras, D. Van Merode, G. Tabunshchyk? Project Oriented Teaching Approaches for E-learning Environment IEEE 9th International Conference on Intelligent Data Acquisition and Advanced Computing Systems (IDAACS), 2017. pp. 317-320. DOI: 10.1109/IDAACS.2017.8095097

INVESTIGATION OF THE METHODS OF ADDRESSING THE ELEMENTS OF THE MATRIX IN THE DYNAMIC DISPLAY OF GRAPHIC OBJECTS

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Abstract: *The purpose of the article is to study and analyze widely used methods of addressing elements of LED matrices, as well as schematic implementations of such matrices. A comparison of possible methods of addressing and activating elements for various schematic implementations of these matrices is conducted in order to identify the most effective combination of circuit design implementation and the method of addressing and activating the elements that most fully meets the requirements.*

Keywords: matrix of lighting elements, 3d-displaying, dynamic indication, flat LED matrix, LED array, LED array addressing, LED array circuit.

1. Introduction

The proposed method of spatial display of graphic objects [1] requires a high-speed display of the sequence of frames on the flat surfaces of the LED matrix. As the resolution increases, the number of matrix elements increases as well as the number of displayed sub-frames, and the number of display points increases not in proportion to the increment of the elements of the matrix and also takes into account the increase in the number of still frames. The formula for calculating the number of display points (per second) is as follows:

$$Fx = Dx * Dy * K * R \qquad (1)$$

Where: Fx - number of items displayed per revolution of the matrix; Dx - number of elements of the matrix horizontally; Dy - number of elements of the matrix vertically; K - number of stop frames, per revolution of the matrix; R - number of spins of the matrix per second.

As can be seen from the formula (1), the number of points of displayng is linearly dependent on the values of all components and the increase of one value in N-fold leads to an increase in the result in N-times, and with an increase in N-fold two or three components, the result will increase in N^2 or N^3-times, respectively. Given the significant increase in display points when improving the quality of the display itself (increasing the density of the points and their number, increasing the frame rate, etc.), it is expedient to optimize the display process itself directly related to the method of addressing and activation of the matrix elements.

2. Task formulation and evaluation criteria

The main task of the study is the consideration of known circuit design solutions for the implementation of flat LED matrices, as well as the methods of addressing and activating their elements and their evaluation in order to choice the most optimal combination of schematic implementation of the matrix and the method of activating its elements.
The most important evaluation criteria are two of the following: the number of lines of input / output involved and the maximum number of simultaneously activated elements, with different values.

The number of I / O lines involved does not only characterize the hardware requirements, but also the number of physical conductors that must fit between the elements of the matrix. The schematic arrangement of the elements of the matrix used in [1] is presented in Fig. 1.
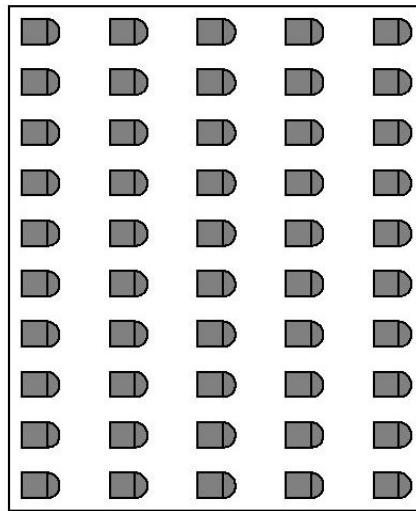

Figure 1. Schematic location of the elements of the matrix

Given that the LED matrix should be as transparent as possible (according to requirements [1]), the number of conductors that arrange the transmission of energy to the LEDs should be minimal, or their sizes are small enough not to shade the light-emitting elements themselves. From the schematic implementation of the connections of the elements of the matrix depend on possible ways of addressing them.

The criterion for the number of maximally activated elements simultaneously affects, first of all, the speed of filling the matrix (alternating activation of all its elements), which in turn dictates the requirements for the speed of the ports of input / output. So, the device [1] uses a matrix of LEDs with the dimension of 5x10 elements of 64 sub-frames per revolution and 16 revolutions per second, which according to formula [1] corresponds to: $Fx = 5 * 10 * 64 * 16 = 51\ 200$ elements per second, relatively small, but also the dimension of the matrix is rather small and, accordingly, the clarity of the displayed 3D model. If you use a 32x32 matrix with the same number of sub-frames and rotational speeds, then the number of displayed elements will be equal: $Fx = 32 * 32 * 64 * 16 = 1,048,576$ items per second, which is already higher than I / O ports in 1 MHz (with elemental activation).

3. Schematic and design features of the matrix for displaying graphic objects

The main circuitry implementations of the connections of the matrix elements are as follows:
- matrix (traditional) scheme [2];
- Individual connection of elements;
- Charlieplexing [3].

The connection on a matrix circuit (Fig. 2) represents X bus lines and Y columns of tires, a LED is connected between each row and each column. The lines are scanned one by one (one negative voltage, on all others positive or Z-state), the voltage is applied to the column (negative if the diode is lit, negative or Z-state - if not). The current will only pass through those LEDs that connect the negative column and the positive line.

When you need to save the outputs, it is desirable to make X and Y extremely close, or equal. Without the use of an external decoder with 2n outputs, you can get n² LEDs.

If the voltages are such that the LEDs need resistors, they must be connected not to rows X but to the columns Y.
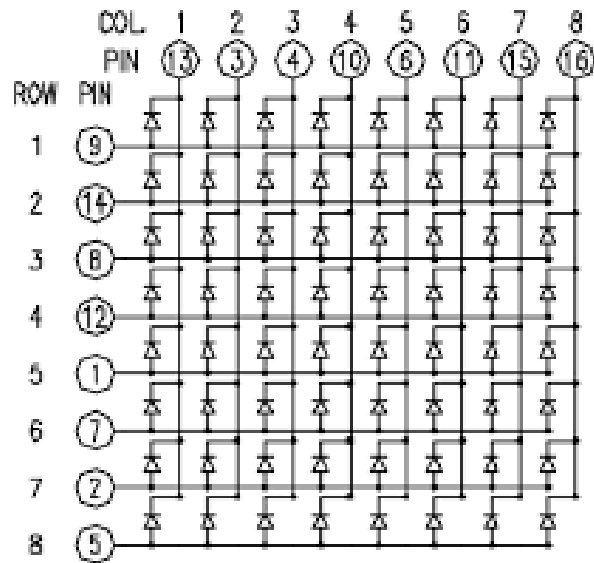
Figure 2. Matrix scheme of connection of elements [4]

The matrix scheme of connections of elements of the LED matrix above introduces only the display of monochrome images, in order to expand the color gamut and bring it as close as possible to the color gamut, the perceived human eye can use RGB LEDs [5] that combine LEDs Three basic colors: Red, Green and Blue. The matrix scheme of connections of elements is presented in Fig. 3.
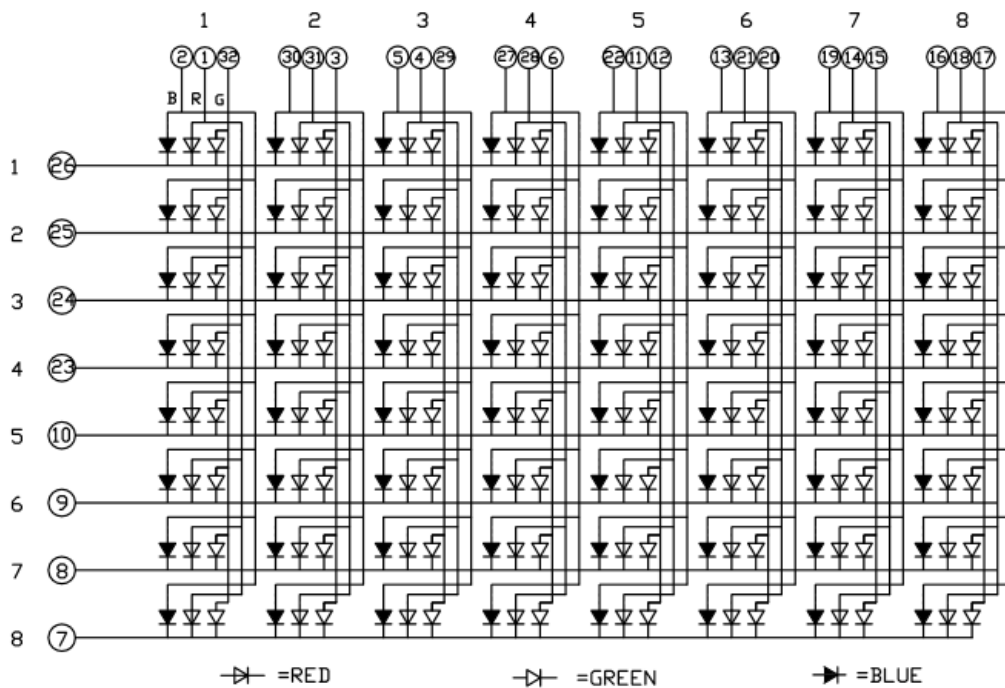

Figure 3. Matrix scheme for connecting elements of the RGB matrix [6]

The individual connection of the elements of the LED matrix is rather cumbersome and complicated in the implementation, therefore, has not been widespread, the main problem is the large number of active control terminals, which is equal to the number of active elements

(LEDs) of the matrix, but besides, these matrices possess the undeniable advantage - high speed of updating image, since all the elements can be updated at the same time. Scheme of individual connections of matrix elements is shown in Fig. 4.
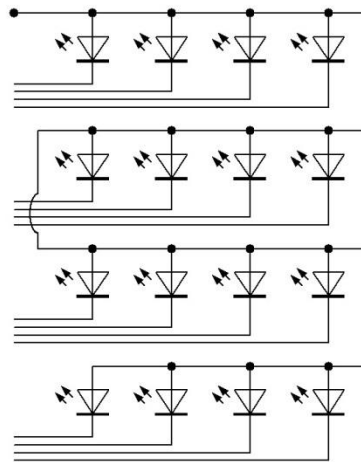

Figure 4. Individual connection of matrix elements

Charlieplexing - Charlie's Method. In Charleplexing, three states of foam microcontroller are used. For one pin, a high voltage is applied, the second low (minus), and all other foams are switched to the input. In this mode, they pass into the so-called high impedance state or Z-state. This means that the foam has a very high resistance, and the current through them almost does not flow. As shown in Fig. 5, the scheme to apply high voltage to the first line, low to the second and transfer the remaining foam to the Z-state, then the current will go through the LED LED 10, and all other LEDs will not burn. Often, switching an active LED, you can create the illusion of simultaneous combustion of several LEDs.

Charley's method allows N foam to operate with N * (N-1) LEDs. For example, by employing 8 foams you can operate 8 * 7 = 56 light diodes.
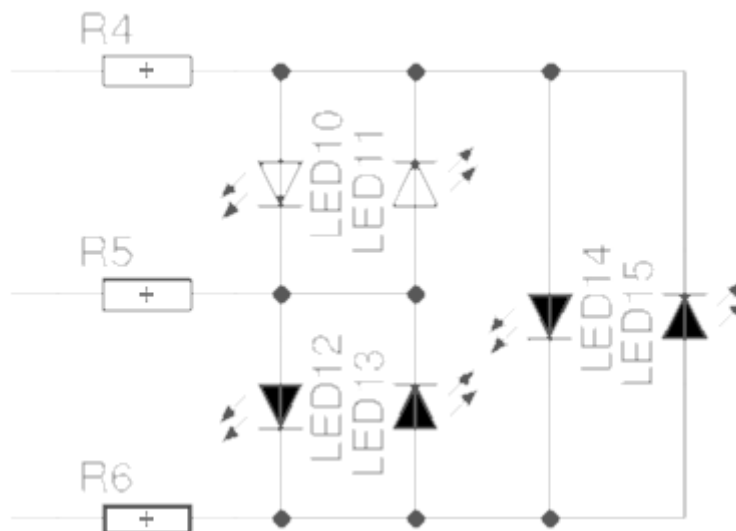

Figure 5. Scheme for implementing the Charlie method [7]

All outputs in the Charleplexing Indicator should be triple. If the microcontroller current is enough to light the LED is not a problem, but external three-digit drivers require two outputs for each one, which deprives Charley's main advantage of saving output.

Most of the LED matrices are made on a plane with an opaque lining [8] (Fig. 6a), there are also curvilinear LEDs [9] (Fig. 6b), LED arrays, and also without frameworks [10] (Fig. 6c), in which the frame is the output the very elements (LEDs).
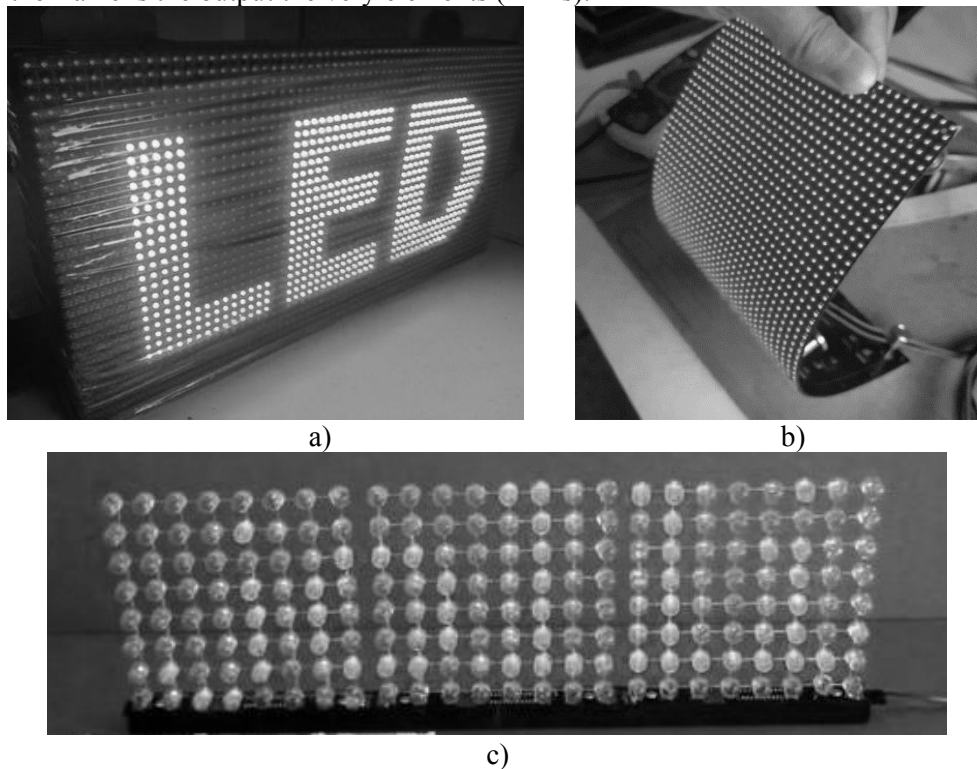

| a) | b) |

c)

Figure 6. a - the view of a flat, monochrome, LED matrix; b - the curvature of the LED matrix; c - the view without frame LED matrix.

4. Methods of addressing and activating matrix elements

In order for the matrix to effectively display the graphic information it is necessary for it to be filled with new data as soon as possible, that is, it quickly updated the frames, and for this purpose it is necessary to use as many elements of the matrix as possible to display simultaneously for display. For example, if a matrix of 50 elements is filled in by one element, each element will shine 1/50 part of the time allowed for the glow of the entire matrix, and therefore the brightness of the glow can be reduced by 50 times. And if the matrix is filled in groups of elements by 10 pcs, then each group will glow 1/5 of the time of the glow of the entire image. If all the elements of the matrix are simultaneously applied, then you can achieve the maximum speed of the change of images and brightness of the luminescence.

Each of the matrix elements involved in the matrix schematics: the matrix (traditional) scheme, the individual connection of the elements, and the Charlieplexing ("Charleplexing"), can only implement certain methods of addressing and activating the matrix elements presented in Table 1.

Table 1. Permissible addressing and activation methods for matrix elements

Possibility of addressing / activation	Schematic realization		
	Matrix scheme	Individual connection	Charlieplexing
By elemental addressing	+	+	+
Activation horizontal/ vertical	+	+	+
Independent activation of items	-	+	-/+
Activate all items at once	+	+	-

The step by step element addressing represents the activation of the matrix elements one by one, lighting it for a certain period of time, during which the LED drops and activates the next, thus activating all elements of the matrix. This method of activating the elements takes a considerable amount of time to output the entire matrix, and also the molded image has low brightness. But along with the disadvantages of this method of activating the elements consumes very little energy therefore the outputs of the matrix (its elements) can be fed directly from the microcontroller.

The method of activating matrix elements at once with the whole horizontally / vertically allows one element to activate all the necessary elements vertically or horizontally (depending on the implementation of control elements). With this method of activating the elements, acceleration is achieved at the speed of filling the matrix, and also the brightness of the luminescence of the molded image increases, and both parameters increase in proportion to the number of elements in the horizontal / vertical.

Independent activation of the elements of the matrix involves the activation of any elements in any number simultaneously, that is, the simultaneous formation of the entire image in one cycle, which allows you to get the maximum speed of the image and its high brightness.

Activation of all elements of the matrix is required at the same time in the process of checking the stability of the position of all points within the reflection space. And also in some other cases.

5. Comparison of addressing methods for matrix elements and the choice of the optimal combination of matrix design and addressing its elements

The main criterion in choosing the schematic implementation of the connections of the elements of the LED matrix is their simplicity and linearity, since such a matrix should be as transparent and non-accumulated conductor lines, in this case the most suitable schematic implementation of the connections of the matrix elements is a traditional - matrix circuit, where the conductors that ' The elements of the matrix are joined by horizontal and vertical parallel lines that meet the requirements as much as possible.

The schematic implementation of the matrix elemental (step by step) addressing requires a very large number of conductor lines, which will cause a significant shading of the matrix and worsen its transparency, and also such a matrix requires a fairly large number of microcontroller output leads, causing certain problems.

Charlieplexing (or Charley's method) involves a counter-parallel connection of LEDs, as well as three-valued logic (high, low, and Z-state) which leads to the shading of the matrix with conductors and also, with the use of external drivers, will not win in the involved lines of the microcontroller.

Therefore, in terms of schematic implementation of connection of matrix elements, the most optimal option is the traditional circuit, since it holds out most of the required methods of activating elements, has minimal shading, and also uses a moderate amount of microcontroller outputs. So for a matrix of 32x32 elements, such a scheme of connections will require 32 + 32 + 64 wirelines and will be able to address 32 * 32 = 964 elements.

The fastest way to fill a matrix performed on a traditional circuit is a method for displaying the opening of all the necessary elements of the horizontal or of the vertical of the matrix, and thus, alternately actuated vertically / horizontally all of the elements in turn with this method of activation of the elements of the matrix, the matrix of 32x32 elements can be activated in 32 steps, activated immediately by 32 elements.

6. Conclusion

As a result of studying the variants of the addressing of the matrix elements in the dynamic mapping of graphic objects, widely used methods of addressing elements of LED matrices and schematic implementation of such matrices were analyzed and analyzed. A comparison of

possible methods of addressing and activating elements for various schematic implementations of these matrices is conducted in order to identify the most effective combination of schematic implementation and the method of addressing and activating the elements. It was found that the traditional scheme of technical implementation of joints of matrix elements in conjunction with the traditional way of filling / mapping the matrix - horizontals / vertices is most suitable for the method of spatial display of graphical information. This combination provides an acceptable matrix filling speed while affecting a relatively small number of conducting lines, but most importantly - this scheme provides technical implementation of the framework of conductors that connect the elements of the matrix.

7. References

[1] Dortmund International Research Conference 2018, 29-30 JUNE 2018: METHOD OF SPATIAL DISPLAYING THE GRAPHIC INFORMATION - Kanyovskyi A.A., Kochan V.V.,Sachenko A. O.

[2] Wikipedia: LED display Homepage, https://en.wikipedia.org/wiki/LED_display, last accessed 2019/04/29

[3] Wikipedia: Charlieplexing Homepage, https://en.wikipedia.org/wiki/Charlieplexing, last accessed 2019/04/29

[4] Treatymonitoring: Arduino Rowcolumnscanning Array LED Circuit Led Array Schematic Homepage, http://12.mjkl.treatymonitoring.de/data/led-array-schematic.html, last accessed 2019/04/29

[5] Pat. US 9,041,025 B2 United States US G09G 3/32, HOIL 27/156, Monolithicfull-color led micro-display on an active matrix panel manufactured using filip-chip technology / Kei May Lau, Zhaojun Liu, Date of Patent: May 26, 2015

[6] RGB LED - Matrix Schematic, Jesse Craig, June 25, 2014, Homepage, http://learnpic32.blogspot.com/2014/06/controlling-rgb-led-matrix-with-shift.html, last accessed 2019/04/29

[7] Eax: Two ways to multiplex LEDs on the example of AVR microcontrollers, Homepage, https://eax.me/avr-multiplexing/, last accessed 2019/04/29

[8] Indiamart: P10 Red Color LED Display Board, Homepage, https://www.indiamart.com/proddetail/p10-red-color-led-display-board-12358954562.html, last accessed 2019/04/29

[9] Linsnled: P4mm Soft LED Display Module, P4mm Flexible LED Panel, Homepage, http://www.linsnled.com/product/soft-led-display-module-4mm.html, last accessed 2019/04/29

[10] Samodelnie: HOW TO MAKE A MATRIX FROM LEDS Homepage, http://samodelnie.ru/ publ/kak_sdelat_matricu_iz_svetodiodov/1-1-0-259, last accessed 2019/04/29

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