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1. Executive summary

This document describes the Strategic Development & Sustainability Plan (D 6.1) of the project GAIN. The plan comprises the description of organizational development and transition process of the target institution MICM, towards the sustainable institutional model beyond the GAIN project.

Document History			
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2. Introduction

One of the objectives of the GAIN project is to continuously evaluate the impact of the project activities on the R&I capacities of MICM and design the subsequent follow-up measure to ensure the sustainability and organic development of the project results.

The project supports the organizational changes in the target institution MICM from the widening country Georgia, aiming at building modern research administration and management capacities, introducing effective governing principles and processes typical for European research organizations (the European partners will serve as models). This will include the introduction of an internal achievement-rewarding system, international Scientific Advisory Board, project-based research organization with roadmapping practices for internal projects, etc.

Sustainability of the project's results will be ensured by the extended Twinning Research and Innovation Programme (TRIP), which is designed as a system of joint and mutually complementary mini-projects and is an organizational and directing framework uniting all capacity building activities in the project. The scientific results foreseen by TRIP will compose the fundamental for the continuous cooperation beyond the GAIN project. One of the most visible of such results will be the Joint Virtual Laboratory integrating the complementary resources of the project partners, which will be established in 2024. The Joint Virtual Laboratory will integrate the most advanced and successful project collaborations. The partners will agree on the mechanism ensuring the sustainability of the laboratory operation outside the project framework (e.g. on the basis of joint projects acquired during GAIN, internal financial resources, innovation activities), which will be included into the TRIP sustainability plan to be developed and agreed by the end of the project. Strong dissemination path

based on the open science and research data principles will facilitate the sustainable development of the project's results. GAIN will produce open access research publications and scientific data.
To practically apply acquired knowledge and skills, in 2025 the project will implement a Pilot Innovation Project based on the results of the TRIP and on the project MEPHESTO, which naturally integrates the TRIP research directions. This will enable MICM to submerge its research personnel into the running cutting-edge European research endeavor.

3. MICM long term vision

3.1 Role of MICM in the Georgian science system. Vision and Mission

Muskhelishvili Institute of Computational Mathematics (MICM) was founded in 1956 as a Computing Center of the Georgian Academy of Sciences. Later it was given the name of the famous Georgian mathematician, Niko Muskhelishvili, who was the initiator of launching at MICM the first computer cluster in the country. The mission of MICM was the development of various methods of computational mathematics, wide application of the electronic-computing technique of that time, bringing up Georgian scientists and engineers of the first generation in the relevant fields and implementation of the government orders/tasks[1].
Research has been focused on various fields of mathematics and science, such as: Computational Methods, Probability Theory and Mathematical Statistics, Game Theory, Operations Research, Numerical Methods, Optimization Theory, Approximation Theory, Coding Theory, Mathematical Physics, Functional Analysis, Information Technologies, etc. Modelling the economy and management problems, posed by the government, there were elaborated various software packages of applied character, and some of them even implemented in real life.
The collapse of USSR and subsequent events in 1990-ies had a vast negative impact on the whole science system of Georgia (as well as in other former soviet republics). The funding of science and education in research institutes and universities were driven to minimum.
The first serious reforms of the science system in Georgia started in 2004, when the former Academy of Sciences (of which all research institutes were members) was reorganized. The function of distribution of supplementary financial support for science was delegated to the new structure, Georgian National Science Foundation GNSF, now Shota Rustaveli National Science Foundation – SRNSF.
In 2010, MICM merged to the Georgian Technical University (GTU) as an independent research institute. The academic positions (full, associate, or assistant professor) combine both research and educational activities. It is important to note that since the beginning of 2000, most Georgian universities had joined to Bologna Process.
Currently, MICM maintains high potential in most of the above-mentioned fields, which are classical, traditional branches of mathematics, and there are still many contemporary, challenging problems, successfully tackled by the researchers at MICM. But, on the other hand, MICM is lacking the

[1] In the Soviet era, the government was only a source for practical, applied tasks, as there was no term "Business" in Soviet Union.

inclusion in the development of most modern, cutting-edge technologies such as, for example, Artificial Intelligence (AI). Hower, based on the existing research potential, enriched by the young scientists trained within the GAIN project, MICM is capable to create capacities for new scientific direction such as Machine Learning (ML) technologies, regaining in this way its central place of a propagator of new knowledge and technologies in the R&I system of Georgia, held since its foundation and up to 1990-ies. With the support of the GAIN project, MICM will build a new quality of research capacities in the field of AI. Collaboration with European partners will enable the Georgian researchers to raise their professional qualification in the mentioned field, publish in prestigious journals and present at leading conferences. Thus, in this way, MICM increases its scientific reputation.

One of the drawbacks of R&I system of Georgia is that the research is still isolated from business and industry. The GAIN project brings new opportunities in this respect as well. As noted above, one of the goals of the project is to strengthen research management capacities and administrative skills of the staff working at MICM, to make the relevant structures responsive to the evolving environment, capable of competitive fundraising, and supportive towards innovation. Dissemination and communication activities will address the research audience, policy-makers, authorities, businesses, and the general public in Europe and in the South Caucasus region, in order to shape an image of MICM as a regional center of excellence.

Within the GAIN project the joint work is conducted on several applied AI research topics addressing domains of medical applications (exemplary eHealth application for early detection and monitoring neuro-degenerative, mental and mood diseases) and other relevant application areas. All these application domains have socio-economic importance.

To foster scientific excellence and networking capacity building at MICM and lay the groundwork for strengthening the research potential of MICM in the field of AI, the first step undertaken was the recruitment of young researchers. Majority of the researchers of GAIN-MICM team are young scientists. By the support of the GAIN project, new research positions were created within the research departments of the institute held now by the students of the GAIN with the tenure-track position. These young scientists form the core of a new research unit, the "MICM AI Lab", which is a focus team for the development and design of new research directions in the field of AI at MICM.

In view of the above, the Mission of MICM is:

- To be a best example in the South Caucasus region of a European type of research organization by introducing effective governing principles
- To lead research in the field of AI in Georgia and South Caucasus
- To be regional Center of Excellence in Information Technologies and related fields of Mathematics
- To be a regional Computational Hub with high throughput computing center.

3.2 Quantifiable view of MICM in 2024 and beyond the project

Currently the total staff of MICM consists of 59 employees. Among them, 28 hold the research positions: 13 principal researchers, 4 senior researchers, 11 researchers[2]. Before the start of the GAIN project, there were 5 IT specialists at the institute. In 2022 – 23, with support of the project,

[2] 1 position of a researcher was created with support of GAIN in 2023

the IT team was strengthened by creating 3 positions of assistant-researcher, which are held by 1 PhD and 2 Master students of Computer Science.

In summary, research at MICM is carried out by 28 researchers (by position) and 8 IT specialists and computer scientists. Among them 9 are young (2 PhDs, 3 PhD students, 2 Masters, and 2 Master students), and 8 of them are the members of the GAIN-MICM team. Among the total of 36 researchers and IT specialist, 19 hold full positions, 17 hold half of the positions.

The percentage of staff members with doctoral degrees is 80%. The percentage of women in research staff is 16%.

Table 1 in the Appendix shows the targeted by 2025 - 2030, after the end of the project, and current Institutional Key Performance Indicators, KPIs, used to monitor the evolution of MICM capacities within the GAIN project.

While some indicators such as publications, conferences, doctoral degrees, are in line, even exceeding in some cases, the targeted values, the other indicators like publications/presentations co-authored by young researchers, MSc and PhD dissertations defended, international project proposals need to be improved. This will be accomplished throughout the project based on the internal planning and growth of research expertise.

As seen, most of the items of Innovation and Economic performance and Human Capital are considerably distanced from the targets. This problem should be handled by inclusion of the government authorities. MICM administration, in cooperation with the administration of GTU, will present the Institutional Development Plan to the Georgian Ministry of Education and Science at the end of the project.

4. Scientific development strategy

4.1. Traditional areas of expertise

Nowadays there are 4 research departments in MICM:

- Department of Computational Methods
- Department of Probabilistic and Statistical Methods
- Department of Mathematical Modelling
- Computational Center.

Traditional areas of research comprise Computational Methods, Probability Theory and Mathematical Statistics, Numerical Methods, Approximation Theory, Mathematical Physics, Functional Analysis, Information Technologies with applications in optimisation and modelling the construction engineering, economy, health and management problems.

Diagram 1 in the Appendix shows some indicators of research performance in 2022 and 2023.

4.2. Newly developed areas of expertise

The GAIN project gives unique opportunity to develop new areas of expertise at MICM, namely 2 subfields of AI, AI methods for Human behavior recognition and Natural language processing (NLP), both with applications in healthcare. Mor specifically, the following 3 topics are chosen:

1. ***Topic 1.*** *AI Methods for Deep Speech Analysis in Health (Leader: DFKI);*
2. ***Topic 2****. AI Technologies for Human Behavior Understanding (Leader: INRIA).*

Topic 3 is based on the results of the Topics 1 and 2:

3. ***Topic 3****. Pilot Research Project at MICM, based on (but not limited to) the bilateral (INRIA-DFKI) large-scale project MEPHESTO.*

After the series of weekly web-workshops and supervision meetings organized by French and German partners, 6 research thematic groups (sub-tasks), supervised by the researchers from DFKI and INRIA, were composed:

1. G1. EEG/EDA/ECG (Unimodal EEG/Multimodal [RGB+EDA+EEG]/Implicit Intent Recognition)
2. G2. Face (Emotion RGB or Multimodal [RGB+audio+Text])
3. G3. High-Level Behavior Analysis (Personality)
4. G4. High-Level Behavior Analysis (Behavior disorders: Alzheimer, Schizophrenia, Bipolar, Depression)
5. G5. NLP
6. G6. NLP-fMRI.

GAIN research activities at MICM are concentrated in the "MICM AI Lab", operating since the start of the project.

4.2.1. Topic 1. AI Methods for Deep Speech Analysis in Health

Natural Language Processing and Speech Analysis demonstrates outstanding progress in the field of innovation and technology transfer. In application areas as e.g. health, particularly digital phenotyping of various mental and mood disorders, where the need to use speech as a source of specific (clinically relevant) information is urgent, a number of research challenges remain high on the research agenda. It includes e.g. unstructured spontaneous speech (inferring affective as well as cognitive pathologies), transfer learning and domain adaptation (train classification models in data-rich languages for further adaptation in data-sparse target languages, e.g. Georgian), small datasets without precise manual annotation, etc. Creation and development of this research direction at MICM, is supervised by the one of the pioneers in this area, GAIN partner DFKI.

4.2.1.1. State of research in Georgia

The field of NLP is relatively well developed in Georgia. There are several research groups working on NLP problems. "Center for Cultural Protection and Technological Development of State Languages of Georgia" at GTU, is the owner of the Georgian Language Corpus[3]. The "Georgian National Corpus"[4] is a comprehensive corpus of the Georgian language covering all stages of its historical development. "Tbilisi AI lab" and "Georgian AI Association" work on small and generative language models. Note the recent works of the scientists from TSU[5] on Georgian language based medical records, Georgian handwritten text recognition, labelled dataset for Georgian toxic

[3] https://corpus.ge/
[4] http://gnc.gov.ge/
[5] I. Javakhishvili Tbilisi State University.

comment classification[6], etc. Besides, small, but open access Georgian Language Corpus is available at Leipzig Corpora Collection / Deutscher Wortschatz[7].
However, to the best of our knowledge, research planned in GAIN on application of NLP methods directly to health (mental) problems is the first of its kind in Georgia.

4.2.1.2. Planned Research Activities and results

Planned scientific results in this direction are:

- Methodology and tools (transcription, annotation, etc.) for developing multilingual corpora of dialogue data for the target application.
- Methodology and tools for transfer learning and domain adaptation, especially for low-resourced languages (e.g. Georgian).
- New solutions for several application areas, e.g. Machine Learning tools for extracting mental/mood disorders' (e.g. depression, stress) bio-markers from speech.

Group 5, Sub-task 5: AI Methods for Deep Speech Analysis in Health, NLP.
The group has developed a benchmark dataset specifically for evaluating the sentiment analysis performance of models trained on the Georgian language.

Group 6 (Sub-task 6: AI Methods for Deep Speech Analysis in Health - NLP-fMRI).
An fMRI experiment is currently being conducted at the RWTH - Aachen, Germany, to study functional reorganization patterns after transient suppression of Broca's area, a vital region for language production. Within the GAIN project it is planned to apply NLP methods to this research. For this purpose, RWTH – Aachen University shared research data with DFKI.

Georgian language corpus: It is planned to use the GTU library's electronic documents to create Georgian language corpus. The work is in progress. The dataset will be uploaded to the Zenodo platform and the GTU and the project's websites and will be open access.

4.2.2. Topic 2. AI Technologies for Human Behavior Understanding

Video Analytics and Computer Vision algorithms enables to measure objectively the behavior of humans by recognizing their everyday activities, emotions, lifestyle, etc. Human behavior can be modelled by learning from a large amount of data from a variety of sensors, to improve and optimize for instance, the quality of life of people suffering from behavior disorders. Data is extracted from a scene observed through a network of video cameras combined potentially with other sensors e.g. medical sensors. New AI techniques, particularly Deep Learning (DL) algorithms, can help improve the quality of life of people suffering from behavior disorders. They can enable a more objective and earlier diagnosis, by quantifying the level of disorders and by monitoring the evolution of the disorders. AI techniques can also learn the relationships between the symptoms and their true causes, which are often hard to identify and measure. Creation and development of this research direction at MICM, is supervised by the distinguished European institution, GAIN partner INRIA.

[6] See e.g. https://doi.org/10.1016/j.jjimei.2022.100062
[7] https://wortschatz.uni-leipzig.de/en/download/Georgian

4.2.2.1. State of research in Georgia

Applications of Video Analytics and Computer Vision technologies are becoming common in the business and governmental sectors of Georgia. These are the smart cameras for face and plate number recognition, motion trajectory and fire detection systems, etc. But relative to Topic 1, research in this direction is weakly developed. To the best of our knowledge, there are small groups in several Universities and AI companies conducting research by use of these technologies. The same is true regarding research in Human Behavior Understanding. Moreover, in respect of its application to psychiatry, or generally in medicine, our research is the first of its kind.

4.2.2.2. Planned Research Activities and results.

In this direction, the following use-cases are considered:

- ✓ Machine learning for video, behavior and other bio-signals analysis for medical applications.
- ✓ Deep learning-based systems for people detection and tracking cross-cameras.
- ✓ Deep learning-based systems for activity detection through Video Analytics.

Group 1 (Sub-task 1: AI Technologies for Human Behavior Understanding, Emotions (face crop video, biosignals) is working on 2 projects initiated and suggested by INRIA and DFKI researchers:

- Project 1 is focused on emotion recognition from video. 1 joint research paper is prepared, and a conference talk is given at an international conference (see Appendix, Publications, [10]; Conference talks [2]). Corresponding open source software VideoMAE is available at https://github.com/EmotionLab/EmotionVMAE.
- Project 2 deals with the problem of emotion recognition from EEG signals. The results of this project are reflected in the joint research paper, which is almost ready for publication, and 4 conference talks, given at international conferences (see Appendix, Publications, [11]; Conference talks [3, 4, 16, 17]). Corresponding software EEGAIN is available at https://github.com/EmotionLab/EEGain

In the context of sub-task 1, GAIN Workshop[8] "EmoRec EEG: Generalizability of Emotion Recognition from EEG signals" will takes place in Glasgow, 15 September 2024, at the International Conference on Affective Computing and Intelligent Interaction (ACII) 2024. Th organizers are 2 young Georgian researchers and researchers from DFKI and INRIA.

Group 2, Sub-task 2: AI Technologies for Human Behavior Understanding, Emotions (full body video). Group is currently in the process of developing new approaches to recognize emotions from body movements. The multi-object tracking computer vision model ByteTrack is used for tracking objects (humans) in videos, getting their bounding boxes, IDs and coordinates.

Group 3, Sub-task 3: Action detection/recognition (AI Technologies for Human Behavior Understanding). The group is investigating and implementing new methods for action recognition from video. The main components of the architecture are proposed by the French partners. 1 paper [2] is published.

[8]Workshop link: https://emotionlab.github.io/EmoRec-EEG/

EEG dataset: Aside from the above tasks, planned by the project, two types of experiments are conducted at MICM, which involve the recording of Event Related Potentials (ERP) with a commercial Unicorn Hybrid Black EEG device purchased by the GAIN project. The dataset and its analyses will be ready for publication after 20 recordings (each including 2 sessions per participant). Up to this day, 8 records have been conducted and the experiment is still in progress. The research material and the dataset will be uploaded to the Zenodo platform as well as the website of the project and will be open access.

4.2.3. Topic 3 Pilot Research Project at MICM

One of the vehicles for the GAIN project is the bilateral (INRIA-DFKI) large-scale project MEPHESTO entitled Digital Phenotyping for Psychiatric Disorders from Social Interaction.

The Pilot Research Project at MICM with the same title will be conducted in Georgia. The partner institution of the task is Tbilisi Mental Health Center, where the clinical data is collected. The data is stored on the computer server at MICM for further investigation by the project partners and is handled in accordance with the Consortium Agreement, GDPR and the Ethics Protocol.

4.2.3.1. State of research in Georgia.

The Pilot Research Project "Digital Phenotyping for Psychiatric Disorders from Social Interaction" has no analogy in Georgia.

4.2.3.2. Planned Research Activities and results.

- Important project (baseline) elements, which will be used for joint research and GAIN capacity building, include the following:
- Creation of a multimodal (multilingual) corpora including speech, video, and biosensors of social patient-clinician interactions, serving as the basis for deriving methods, models and knowledge;
- Technical tools and organizational methods for the management of data, including aspects of both ELSI and GDPR requirements compliance;
- Development of AI methods for extracting digital bio-markers from unstructured streaming interactional data;
- Clinical co-creation and validation of digital tools based on the developed methods.

The GAIN's pilot research project will extend the scope of MEPHESTO by implementing the following tasks not foreseen by the MEPHESTO work plan:

- Creation of the Georgian corpus of clinical interactional data (speech and video) using the methodology developed in MEPHESTO. The corpus will represent a unique research tool, which can be used for various research activities in the future.
- Adaptation of feature extraction models and experimentation with clinical bio-markers suitable for digital phenotyping of target disorders.
- Development of novel statistical models for data fusion (e.g. speech- and video-derived features) using multimodal machine learning (MML) approaches, including experimentation with several MML frameworks.

- Development of a clinical demonstrator suitable for validation in Georgia.

The project has supported works of PhD students from INRIA and DFKI (see e.g. paper [11]), and the senior researchers of the GAIN consortium as well (see publications [1, 5 – 10, 12]).

4.3. Human Resources

GAIN research activities at MICM are concentrated in the "MICM AI Lab", operating since the start of the project. The Lab consists of 26 researchers, out of which 15 are the employees of MICM. In total there are 19 young researchers involved in the project. The Lab is interdisciplinary consisting of computer scientists, mathematicians, psychiatrists and psychologists from various universities, institutions and AI start-up companies. The AI Lab will be supported by the project throughout its duration with a perspective on future institutional development and growth with the help of governmental funding and other sources as well, like grant projects etc. It will be part of the "Joint Virtual Laboratory" which will be composed in 2024 by the GAIN consortium partners.
Worthy to note that the research, conducted by all Georgian students is highly assessed by the German and French partners.

5. Strategy for Human Resources development

One of the strategies defined by the GAIN project is building on available competences of the staff and attracting young researchers with new competences to rapidly develop modern research capacities in AI, to create and promote several attractive research positions for young researchers at MICM. GAIN offer them effective training and appealing career development prospects.
To radically improve the long-term prospects of research excellence at MICM, the project will invest in young talents. The system of research workshops, webinars, conference and summer schools will create a forum and breeding ground for young researchers in order to build research reputation and establish networks for future partnerships. The pragmatic goal is to foster at MICM 3 new research groups led by young leaders (age under 35) with the potential and perspective to be Principal Investigators in European R&I projects.
The GAIN project focuses its efforts and resources on networking and promoting young talents. This is reflected in (1) the selection of individuals for participation in research and capacity building activities; (2) carrying out activities specifically targeting young researchers (e.g. Summer Schools); (3) direct supervision and mentoring of young researchers at MICM by the leading researchers at INRIA and DFKI.
To achieve the above goals in promoting the career and retaining the young scientists at MICM, the project has implemented the following measures.

5.1. Tenure-track Positions

Four Tenure-track Positions (post-contract evaluation and, in case of fulfilment of upfront declared KPIs, – a tenure position granting) were created at MICM. The positions were agreed upon by the TRIP[9] steering board.

5.2. New employee positions at MICM.

MICM, aiming at recruiting young researchers has created 4 new employee positions within the research departments of the institute:

- Researcher – 1 competitive position at the department of „Computational Methods "
- Assistant Researcher – 3 positions at the „Computational Center ".

Above mentioned 4 young researchers with tenure-track positions, now hold these positions.

5.3. Promotion of talented young researchers.

One of the important achievements of the project is the identification of talented young Georgian researchers with additional skills of leadership. As set out in the project, 3 directions are composed at MICM and are led by 3 distinguished students, holding tenure-track positions.
MICM plans to agree creation of the 4th direction, Communication Recognition, with the TRIP steering board, which will be leaded by a tenure-track student.

5.4. Staff Exchange.

The Staff Exchange (mobility) Scheme is necessary to carry out collaborative research. In the GAIN project, the program enables task-specific trips with clearly identified purposes from one partner organization to another. They are linked to the 6 research Sub-tasks of 3 Sub-Projects given above and the Tenure-track Positions defined by the TRIP.
According to the Staff Exchange (mobility) Scheme, agreed upon the TRIP steering board, 4 Georgian students will visit INRIA and DFKI. The visits will start in Spring-Summer of 2024, and the duration of each visit will be approximately 3 months.
Possibility for the double supervision (second supervisor from INRIA or DFKI) for Georgian students is being considered. GAIN will support this in the frames of the DoA of the project.

5.5. Training and the Summer Schools.

Participation in research and capacity building activities such as research meetings and training events is one of the main stimuli for a scientist for the career promotion, for establishing research (and personal) contacts. This is especially important for young, beginner scientists.
The main permanent tool for the research collaboration within the project, the weekly webinars of the thematic groups supervised by the French and German partners, INRIA and DFKI, started already in the beginning of the project in 2022 and continue to this day. Researchers of the GAIN consortium are actively involved in this process.

[9] Twinning Research and Innovation Programme (D 2.1 of the project)

Most importantly, the weekly webinars were supplemented by larger project events (many of them in person). More specifically, during the reporting period, the GAIN project has organized 6 meetings:

1. Kick Off Meeting at MICM (October 2022),
2. MEPHESTO & GAIN meeting at INRIA, Sophia Antipolis (January 2023),
3. On-the-job training for Research Administrators and Managers organized by EXOLAUNCH at Technical University of Berlin, (August 2023).
4. The First GAIN Summer School at INRIA, Sophia Antipolis (September 2023).
5. Web-based training on European innovation tools (online, December 2023).
6. Innovation training workshop for researchers and managers at MICM, Tbilisi (January 2024).

These events, focused on the young researchers, together with the intensive research collaboration enabled the project consortium to establish close personal relations among the partners, especially in the thematic groups and built the fundament for future partnership. The first impression of the research abilities of Georgian counterparts was generated at the Kick Off Meeting, were they presented an example of AI application for a specific medical problem. At the MEPHESTO & GAIN meeting at INRIA, Sophia Antipolis, France, and On-the-job training for Research Administrators and Managers organized by EXOLAUNCH at Technical University of Berlin, Germany, GAIN-MICM team members had an opportunity to meet with various research teams, attend the workshops on different topics, visit various research departments and labs to feel the flavor of European research environment of the highest level. Moreover, at the GAIN First Summer School at INRIA, Georgian students presented 5 talks about the results of joint research. A total of 27 person/trips was spent for young Georgian researchers for those 3 visits abroad.

More visits are planned in the second half of the project. These are the training visits at partner organizations and scientific conferences and workshops with high ranking. For example, 2 young Georgian researchers, together with the researchers of DFKI and INRIA, are the organizers, and will attend, the GAIN Workshop "EmoRec EEG: Generalizability of Emotion Recognition from EEG signals", to be held in Glasgow, UK, September 2024, in parallel to the International Conference on Affective Computing and Intelligent Interaction (ACII) 2024. MICM will host a second Summer School In 2024, and a large conference in 2025.

By involving the researchers of MICM into their mainstream research projects, European partners will enable them not only to raise their professional qualification, but also to publish on high international level and to present at leading conferences. This is the main way how scientific reputation can be raised. In this respect, worthy to note 3 joint publications [8, 10, 11], which are in the process of preparation.

The target publication opportunities, conferences and respective KPIs are given in the Table 1 in the Appendix.

6. Stakeholders

The major local, Georgian stakeholders, who would need and apply research results of Topics 1,2 and 3, are the healthcare centers. For instance, these are first of all the project partners from Tbilisi Mental Health Center, where the clinical data is collected (Topic 3). Human Behavior Understanding

is one of the major challenges in psychiatry, enabling a more objective and earlier diagnosis acquired by analyzing EEG[10] (brain signals), biosignals, video, and speech data. In this respect, GAIN will provide corresponding AI Technologies based on Computer Vision and NLP algorithms. MICM and the representatives of the Center intend to submit a joint research proposal to Shota Rustaveli National Science Foundation grant contest in 2024. There are several other groups of physicians as well, with whom opportunities for cooperation is discussed.

Research results obtained in the GAIN project will be of interest for other stakeholders as well.

NLP algorithms designed through Topic 1 will attract the business and industry. Possible local stakeholders are the companies and institutions needing and using language translation, autocorrect, autocomplete, and predictive text, data analysis workflows, text analytics, etc. GAIN-MICM team partners with the start-up companies Helio.AI, Georgian AI Association and Tbilisi AI Lab, and the joint research is planned towards the relatively new approaches in NLP, like small and generative language models.

Deep Learning (DL) algorithms have many applications in natural sciences, like biology, chemistry, high-energy physics and in mathematics as well. These branches of science are relatively well developed in Georgia and MICM has established research contacts with relevant institutions. The latter are, e.g. 13 research institutes of GTU, Agladze Institute of Inorganic Chemistry and Electrochemistry from Javakhishvili State University (TSU) etc. In this respect, the results of Topic 2 will be most relevant. As to the business and industry, the possible local stakeholders are the companies needing and using image captioning and visual recognition, advertising, music and entertainment as well as filmmakers, policymakers and authorities needing e.g. demographic and election predictions etc. In this regard, MICM partners with several AI startups using DL algorithms, e.g. Helio.AI with recruitment business, etc.

Except the GAIN project partners, MICM has working contacts with the universities and institutions from Germany, France, Switzerland, Italy, Romania, and others. MICM is a member of EDU AI consortium, collaborates with EU-funded projects - Sister Twinning Projects Focus Group, initiated by the project EPIBOOST. The first steps to establish working contacts to AI-related European networking initiatives such as AI4EU, CLAIRE, ELLIS, etc., have been undertaken. Recently, RAIT 88, Defense engineering center, Italy, expressed interest in collaboration on Language Models.

7. Funding Opportunities

7.1. Basic funding

The adequate basic funding is crucial for successful functioning of a research institute. According to the National Statistics Office of Georgia (Geostat), average monthly nominal earnings in Georgia, at the end of 2023 was 2045 Gel (approx. 730 Euro), and the average monthly nominal earnings of employees in 2022 was 1543 Gel (approx. 550 Euro). The diagram below shows the dynamics of growth of the latter.

[10] Electroencephalograph

Notwithstanding the growth trend, which positively affected the science sector in research institutions as well, in 2024 the average monthly salary of researchers working full time, e.g. in MICM, equals 900 Gel (20% tax to be deducted). Taken together, including 17 half time researchers, the average equals 680 Gel. Maximum salary, for the head of a research department, equals 1200 Gel (approx. 430 Euro). As seen, lack of funds in research institutions is the global (in the country) issue.

The salaries of newly recruited 3 young researchers, holding the half time Assistant Researcher's positions[11] are even less than the average salary at MICM. Though they are supported by the GAIN project, it will be difficult to retain the built capacities after the end of the project.

To improve the situation, it is expedient to initiate wider dialogue with national Education and Science authorities in order to increase the budget for the research institutes in Georgia.

MICM will undertake the following specific measures:

- Institution Development Plan (to be ready in 2025) will be presented to the Georgian Technical University and Georgian Ministry of Education and Science. The document will include the vision on creation of a new research unit with tentative title "AI Department", its structure, composition and financing. The department will be created based on the existing "MICM AI Lab".
- Administration of MICM, together with GTU, will initiate a dialogue to persuade the relevant Georgian state authorities to allocate additional funds to support the creation of a new research unit "AI Department". Research results of the TRIP and other achievements of the GAIN project, together with European examples and best practices will be the main argument in this dialogue.
- According to the institutional KPIs set out by the GAIN project, the recommended annual research budget for MICM is 0.7 MEuro, against the current 0.191 MEuro. The mentioned dialogue will touch this aspect as well.

[11] The mentioned positions at MICM were created due to free funds, appearing occasionally when employees leave the job.

7. 2. Grant projects

Other sources of funding are local and international grant projects.

The local grant contest of Shota Rustaveli National Science Foundation (SRNSF), announcing the fundamental, applied and other calls each year, are very competitive (MICM researchers have participated in about 12 projects since 2006). At the same time, the maximum budget per year is 80000 Gel (including personnel, travel, purchase and indirect costs), which is too low to support a research group of 4-5 researchers. Nevertheless, in 2024 – 2025, MICM plans to write several proposals, 2 of which are related to the problems posed by GAIN.

As to the international grant projects, MICM has gained experience in ISF, NATO, COBASE, TEMPUS, and 3 FP7 projects[12]. Collaboration within the FP7 GEO-RECAP project[13] (GA # 266155), where MICM was a coordinator, implied new project proposals, joint research projects and collaboration agreements. One of the main results was 2 new EU funded projects, a TEMPUS and FP7[14] projects.

The GAIN project brings new opportunities in this respect. Due to the KPIs set out in the project, the expected number of submitted international project proposals is 10, with a 30% acceptance rate. In this respect, note that MICM is a member of EDU AI consortium. Relevant project proposal (#101120027, call: HORIZON-CL4-2022-HUMAN-02) was submitted, but not funded.

The future proposal ideas will be based on the results of TRIP. During the 2nd and 3rd project years the partners will establish a Joint Virtual Laboratory integrating the most advanced and successful project collaborations. The mechanism ensuring the sustainability of the Laboratory operation beyond the project framework will be ensured by joint projects acquired during GAIN.

An important element of the project exploitation strategy will be the pilot innovation sub-project to be implemented during the 3rd project year. The project will select one of the most promising and high impact research results and implement a set of innovation activities in order to bring it closer to the market.

8. Unique Selling proposition (USP) of MICM

Strength-Opportunity strategies define and reinforce/develop strong niche competences with high complementarity opportunities (research “unique selling proposition”).

As highlighted in the section 3.1, MICM’s goal is to (1) maintain and reinforce its position as a leading AI research organization in Georgia and (2) build its capacities and European profile in order to join the European AI community as a representative of Georgia. In pursuance of this dual goal MICM considers 2 distinctive categories of stakeholders (“customers”) and, therefore, its USP also has two dimensions:

1. In Georgia MICM offers **the broad spectrum of AI competences and capacities** covering the general knowledge over the entire area of AI and computational mathematics with several key competence area (see above). This broad expertise will allow MICM to offer its services to the following stakeholders:

[12] https://micm.edu.ge/en/scientific-activities/institute-projects/
[13] https://cordis.europa.eu/project/id/266155
[14] https://cordis.europa.eu/project/id/609531/

- Industry and public sector stakeholders contributing to modernizing the Georgian economy and society. The set of services will include (1) development of applied solutions/technologies and technology transfer (licensing, start-ups, etc.), thus generating additional revenue streams; (2) raising awareness of the AI-based technology and the impact it has on economy and public sector (e.g. "AI literacy" courses, industry information events and fairs, presentations, etc.); (3) consulting services using the expert knowledge and computing facilities of MICM (e.g. "test-before-invest" services).
- Education sector. By building on its leading research expertise and human resources MICM shall become a reference point in the Georgian Higher Education in the broader area of AI. This will allow MICM to widen the spectrum of educational services, especially on the post-graduate level (e.g. courses, MSc/PhD project opportunities, practical trainings, etc.) provided to GTU, as a hosting University, as well as to offer to other Universities of Georgia. The computing facilities of MICM can be also offered for that purposes. The strategic goal is to make MICM a stepstone for the young generation of AI researchers in Georgia, the main "supplier" of highly qualified AI specialists for the country.
- Government and public services. Our goal is to make MICM a main AI expert body for the Georgian Government, the organization providing expert knowledge to the legislative process. An example: following the adoption of the EU AI Act, the corresponding Georgian legislation shall be reviewed and revised in order to ensure the compliance (as long as Georgia is an EU candidate country) – in this work the professional expertise of MICM in technology and technical aspects of technology applications will be an asset for the legislative stakeholders.
- General public. MICM shall become the central player in promoting AI and AI-based technologies to the Georgian society. For that, MICM establishes close contacts to major media channels and offers its technological expertise in order to increase the visibility of AI and build general AI awareness.

2. In the context of European/international cooperation, MICM will focus on its unique capabilities and **clearly defined niches of research excellence/specia**lization (these areas are defined above). Its international smart specialization strategy will be built on the following unique assets MICM possesses:
    - Traditional expertise in computational mathematics, statistics and other disciplines underpinning the progress in AI. Here, MICM will look for opportunities to join European research consortia carrying out basic research on the foundations of AI.
    - Unique research assets relevant to applied research topics. This includes MICM's specialists with focused and deep research profiles as well as the other capabilities. For instance, MICM will capitalize on the access to Georgia-specific datasets, such as language and multi-lingual interactional data corpora, cultural heritage data, geospatial data for Georgia, etc. In this area, MICM will offer its research capabilities to European research and innovation project consortia pursuing funding

opportunities offered by such Programmes as Horizon Europe, Digital Europe, EIT, and future EU Programmes.

- Pockets of country-specific expertise in the field of research-based Education (mainly post-graduate levels) in the field of AI and related disciplines. Targets will include EU's Erasmus+ and Marie-Curie Programmes.

9. Sustainability

9.1 Sustainability principles and risks

The managerial and organizational principles contributing to the long-term sustainability of MICM as a research organization can be formulated as the following:

- MICM continues its operation and development as an independent research unit within the structure of Georgian Technical University. This will allow the following pillars of support:
  - Major infrastructure maintenance and development. The Institute is located in the newly renovated and upgraded premises owned by the University, which allows carrying out the full spectrum of activities.
  - The permanent staff members are financed by institutional funding from the University budget. The direct involvement in teaching allows to attract young researchers from the student population.
  - The Institute benefits from having access to the general University services, such as accounting, library, IT and communication services, etc., which reduces unavoidable overhead costs.
- Healthy combination of institutional and competitive funding. As indicated above, the basis for the existence of the Institute is provided through its status within the University. At the same time, the external third-party funding (grants, industry projects, services, etc.) represents a critically important condition for the development and long-term sustainability. The quality of research is a very central factor defining the ability to attract such external resources.
- Continuous capacity building. The institute will continue investing in training and motivating young researchers with the goal to change the demographic situation. The same relates to female researchers, who will enjoy special attention from the side of the MICM management. We aim at building a balanced and inclusive team, which will accommodate the people of various ages, professional interests and capacities.
- Diversification of the service portfolio. Despite the fact that research is the core activity, the involvement in other activities such as e.g. education, innovation, consulting, raising awareness, etc. represents an important sustainability opportunity for MICM. This will also result in the configuration of the MICM team, which will have to include the specialists with different profiles.

Risks analysis:

#	Risk description	Mitigation strategy
1	Rapid deterioration of joint activities after the end of the GAIN project funding period resulting in the departure/re-focusing of personnel at all project partners	Pro-active and comprehensive acquisition strategy aiming at the creation of the critical mass of external projects/activities before the GAIN project end in order to enable the funds substitution. Smooth transition of key research and technical personnel to newly acquired projects/activities. Fostering innovation and other activities resulting in private funding.
2	Unwillingness of a GAIN partner organization to continue cooperation activities without a dedicated external funding. Partner organization withdrawal from joint activities.	The remaining partners will re-assess the situation and re-direct the cooperation activities in order to maximize the benefits. Potential adjustments will be designed and implemented in the management of the network to reduce overheads and adjust to the new scope. The technical measures will be considered to compensate for the departing infrastructure.
3	Major crisis in Georgia resulting in re-focusing the funding priorities of principle donors/funders, higher inflation rate, lower demand for contract research, shrinking innovation opportunities, etc. Result: critical reduction of third-party competitive funding at MICM, resulting in reduction of opportunities for motivating key personnel.	If possible, MICM will aim at creating reserves (financial and other resources) to be used to overcome temporary difficulties. Also, close links to GTU shall be reinforced. Revision of the sustainability strategy in order to untap new revenue sources to substitute reduction of traditional funding (e.g. new industrial/thematic sectors, new types of services to be provided, etc.). Reduction of overheads and other costs to an unavoidable minimum.
4	Lack of resources for the MICM's infrastructure maintenance and development, gradual ageing of the infrastructure resulting in difficulties with funding acquisition, performing competitive research and innovation activities.	• Strategic investments into infrastructure using available national resources, including competitive funding. • Cooperation with other Georgian AI teams having significant infrastructural capacities to create synergies. • Diversification of revenue streams by fostering industrial cooperation and investing the resources into infrastructure maintenance.
5	Changing research priorities and evolution of the R&I policies in	Regular research foresight activities at MICM (consultations with GAIN partners) allowing

	Georgia and Europe resulting in shrinking the spectrum of research cooperative opportunities.	an early detection of changing trends and adjustments in research priorities. Pro-active investments in promising research directions in order to create capacities necessary for successful acquisition in the future. Capacity building activities (e.g. mobility, training, education) pro-actively addressing the changes

9.2 Plan for financial sustainability and development

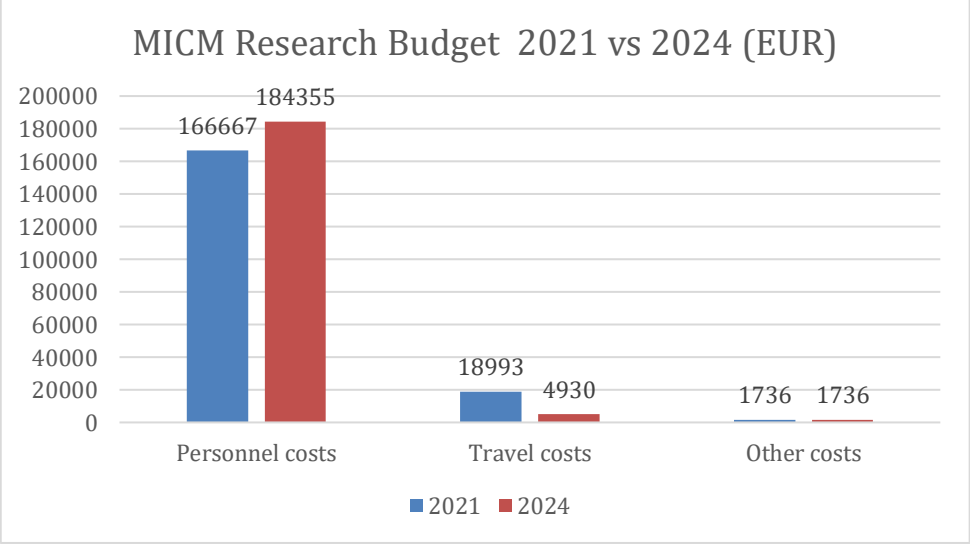
In Section 7.1 we gave a comparative analysis of the average salaries at MICM and in the Country. In this section, we analyze the MICM research budget in more detail and give expected, realistic figures for each cost category. We also compare the latter figures with that of recommended by the institutional KPIs set out by the GAIN project.

We define the ***research budget of MICM*** as the sum of the ***personnel costs, travel costs*** and so-called ***other costs***, which include the organizational costs for workshops, conferences, events, costs to invite the Key-note speakers, etc. As the personnel costs and travel costs categories have been significantly changed during 2021 – 2024 (the first increased, other decreased), to describe the complete picture, we give them in the Table 1 below (see also Diagram 1):

Table 1.

MICM Research Budget (EUR)		
Costs Categories	**2021**	**2024**
Personnel costs	166667	184355
Travel costs	18993	4930
Other costs	1736	1736
SUM	**187396**	**191021**

Diagram 1



The salaries by the research positions are given in Table 2:

Table 2.

Positions (EUR)	2021	2024
Head of Department	393	429
Principal Researcher	321	393
Senior Researcher	286	321
Researcher	250	268
IT manager	257	375
IT specialist	179	250

In 2024, the volume of the governmental annual budget of MICM is about 250,000 Euro, where the research budget is about 191,000 Euro. The share of international project research funding (now including only the GAIN project with annual 82,500 Euro), in the research budget of MICM is about 30% (39% for the total budgets of MICM and GAIN). Taken together, the total research budget of MICM equals 273,500 Euro.

Table 3 shows the distribution of the expected ***personnel costs*** across the positions:

Table 3. Personnel costs expected in 2030.

Positions	Personnel costs	Annual per/position	Number	Annual
Head of Department	1600	19200	5	96000
Principal Researcher	1400	16800	8	134400
Senior Researcher	1200	14400	10	144000
Researcher	1050	12600	12	151200
IT manager	1300	15600	2	31200
IT specialist	950	11400	4	45600
		Average/ 15000	**Total/41**	**Total/602400**

The calculation is based on reorganization of the research and IT staff. Thus, MICM will be able to increase the number of relevant staff to 41 (instead of 36 in 2024), and significant increase of the personnel costs. The average annual salary will equal 15,000 Euro as set out in the KPIs of the project GAIN.

An important side of the reorganization is the creation of a new, 5th research department, "AI Department", which will be based on "MICM AI Lab" functioning within the GAIN project. The AI Department will be leaded by the Head of Department and include: 2 Principal Researchers, 3 Senior Researchers, 3 Researchers, 1 IT manager and 2 IT specialists.

Distribution of the travel and other costs is as follows: ***travel costs*** – 57,600 Euro, ***other costs*** - 40,000 Euro.

Based on KPIs of the GAIN project, the recommended annual research budget of MICM is 700,000 Euro, to be achieved in 2030, 5 years after the end of the project. The expected budget breakdown with regard the categories is given in the table below:

Table 4.

Expected in 2030	Percentage	EUR
Competitive funding	50%	350000
Non-governmental funding	10%	70000
International project funding	30%	210000
Governmental funding	10%	70000

In the existing situation, the ***Governmental Funding*** of MICM is 191,000 Euro (about 27% of the 700,000 Euro recommended in Table 3). In the long run, we may expect that up to 2030, this amount will grow to 210,000 Euro. Thus, we suggest a corrected version of Table 3:

Table 5.

Corrected expected in 2030	Percentage	EUR
Competitive funding	29%	200000
Non-governmental funding	10%	70000
International project funding	31%	220000
Governmental funding	30%	210000

Regarding the ***Competitive funding***, note that currently maximum annual SRNSF grant amount is about 29,000 Euro. In an optimistic perspective of growth (e.g. increase up to 40,000 Euro), 5 funded grant projects would be realistic for MICM.

Non-governmental funding will be obtained in cooperation with the business sector (see Sections 6, 7 above).

As to the ***International project funding***, based on the KPIs set out by the project, having in mind the annual research budget (82,500 Euro) of the GAIN project as an example, 2-3 international projects would be realistic for MICM.

10. Conclusions

The MICM's almost 70-year long history demonstrates that despites all historical transformations and external volatility, the Institute managed to preserve its core mission – it was, is and will be in the center of the Georgian science system as a leading national ICT research institution. The following pillars underpin the sustainability and development strategy of MICM:

- High-quality research as a foundation of all activities in the Institute, contributing to cementing the MICM's reputation as a leading ICT and AI team in Georgia. Different instruments will be used to ensure the leading role in research, namely:
    - Creating best possible conditions for carrying out research activities, including investments in research infrastructure (computing facilities, information access, publication opportunities, etc.)
    - Attracting best (young) talents by competitive working conditions and success-motivating environment. The Institute will continue the efforts to build a balanced research core team with young researchers on leading positions. Active involvement of students in the Institute's research projects will also contribute to attaining this goal.
    - Strengthening the international cooperation activities at MICM with the focus on European integration. Cooperation with leading research organizations like CERN, INRIA, DFKI will be continued and reinforced.
    - Pro-active acquisition of competitive research projects in priority areas through national and international research programmes.
- Turning the Institute into a driver of innovation in Georgia. Based on the excellent research expertise of the MICM's team, the Institute will invest in building innovation capacities in order to transfer the research results into economy. Young research personnel will be motivated and prepared to spin-off research results and create new innovative business. In this work the close cooperation with innovation support services of GTU and national stakeholders will be strengthened.
- Diversification of financial basis of MICM. The healthy balance between different types of funding will provide stability, sustainability and opportunities for development. The following revenue streams will underpin the financial sustainability of MICM:
    - Institution funding provided to MICM as to an integral part of Georgian Technical University. This funding represents and will continue to represent the basis of sustainability to allow the Institute maintaining its infrastructure, providing basic support to the research and administrative core personnel, simply saying - being a "skeleton" to sustain the Institute's structure. Being involved in educational activities of GTU, MICM benefits also from having access to student population (source of young talents), University services and infrastructure.
    - Third-party research funding acquired, under competition, through major national and international Programmes. In addition to demonstrating the quality of MICM's research, this activity will generate important resources for bringing (on a project basis) additional personnel and motivation permanent personnel of MICM. Also, this activity contributes strongly to maintaining the MICM's infrastructure.
    - Revenues generated by the Institute's innovation activities (industrial contracts, licensing fees, patents, etc.). Despite the fact that this type of finding is currently almost non-existent, the experiences and example of the European GAIN partners play an important motivating role to advance in this direction.

- Positioning MICM as a major promoter of digitalization and AI literacy in Georgia. The Institute has all chances to lead the AI revolution in public opinions and life of the country. Building on its professional expertise and engaging with national and international media, MICM will contribute to promoting the proliferation of AI-based technologies. In turn, these activities will contribute to building the profile of MICM in society and public administrations.

11. Appendix

All publications, conference talks and presentations contain references to the European Union and the GAIN project and other relevant acknowledgements[15].

Publications

1. **Philipp Müller, Michal Balazia** et. Al. MultiMediate'23: Engagement Estimation and Bodily Behavior Recognition in Social Interactions. 10.1145/3581783.3613851, https://arxiv.org/pdf/2308.08256.pdf
2. **T. Saghinadze**. Constructing Convolutional Neural Networks with 90 Degree Rotational Equivariance and Invariance. Georgian Electronic Scientific Journal: Computer Science and Telecommunications 2023|No.1(63), p. 39 – 43. ISSN 1512-1232. https://gesj.internet-academy.org.ge/en/list_artic_en.php?b_sec=comp
3. S. Chobanyan, L. Chobanyan, Z. Gorgadze and **G. Ghlonti**. An Algorithm for Finding a Near-Optimal Rearrangement in the Steinitz Functional. Bulletin of TICMI. Vol. 27, No. 1, 2023, 21–27. http://www.viam.science.tsu.ge/others/ticmi/blt/vol27_1/3.pdf
4. N. Abzianidze, N. Dogonadze, **G. Ghlonti**, Z. Kipshidze. About knowledge delivery strategies for intelligent tutoring systems in mathematics and computer science. Bulletin of TICMI. Vol. 27, No. 1, 2023, 29–37, ISSN 1512-0082 http://www.viam.science.tsu.ge/others/ticmi/blt/vol27_1/4.pdf
5. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On one connection between the moments of random variables. Computer Science and Information Technologies CSIT 2023, September 25 - 30, 2023, Yerevan, Armenia. Book of abstracts https://csit.am/2023/proceedings/DMCA/DMCA_5.pdf
6. G. Baghaturia, **M. Menteshashvili**. Application of general integral of quasi-linear equation to solving of non-linear Cauchy problem. Bulletin of TICMI. Vol. 27, No. 2, 2023, 59–65. ISSN 1512-0082. https://www.emis.de/journals/TICMI/vol27_2/2%20Bagaturia_Menteshashvili_23_TICMI.pdf
7. G. Chelidze, S. Chobanyan, **G. Giorgobiani**, V. Tarieladze. Trigonometric series and the permutation sign convergence condition. *Accepted for publication in Analysis Mathematica*.
8. **Kachiashvili K.J., Kachiashvili J.K., Kalandadze R. M., Kvaratskhelia V.V**. Automatic diagnosis of lung diseases (pneumonia, cancer) with given reliabilities on the basis of an irradiation images of patients. *Submitted to the journal "Cancer Investigation".*
9. **T. Agrawal.** Robust and Efficient Multimodal Multi-dataset Multitask Learning. Submitted to AAAI (Association for the Advancement of Artificial Intelligence), 2023.
10. **N. Kukhilava, T. Tsmindashvili, R. Kalandadze, L. Ferrari, V. Strizhkova**. Multimodal emotion recognition with physiological signals and video. *Prepared to submit***.**
11. **T. Tsmindashvili, N. Kukhilava, S. Katamadze, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth** Evaluation in EEG Emotion Recognition: State-of-the-Art Review and Unified Framework. *Prepared to submit***.**
12. **G. Giorgobiani, V. Kvaratskheliaa, and M. Menteshashvili**. Unconditional Convergence of Sub-Gaussian Random Series. Pattern Recognition and Image Analysis, 2024, Vol. 34, No. 1, pp. 92–101.

[15] The authors with bold letters are the GAIN consortium members.

Conference Talks

The conference talks are supported by the GAIN project. Presentations contain the logos of EU and the GAIN project and the relevant acknowledgements.

1. **G. Giorgobiani, V. Kvaratskhelia, T. Saghinadze.** Mathematics of Artificial Intelligence. 2nd Int. Conf.: Science, Education, Innovations and Chemical Technologies – From Idea to Implementation. Tbilisi, Georgia, 23 – 24 November 2023. https://conference23iice.ge/
2. **N. Kukhilava, T. Tsmindashvili, R. Kalandadze, L. Ferrari, V. Strizhkova**. VideoMAE for Emotion Recognition. Second CERN-GTU collaboration meeting PMBC2023, 6 – 10 November 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
3. **T. Tsmindashvili, N. Kukhilava, S. Katamadze, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth**. Evaluation in EEG Emotion Recognition: State-of-the-Art Review and Unified Framework. Second CERN- GTU collaboration meeting PMBC2023, 6 – 10 November 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
4. **S. Katamadze , T. Tsmindashvili, N. Kukhilava, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth**. Enhancing Emotion Recognition: EEG Evaluation and AI Models. DataFest Tbilisi 2023. 9 – 11 November 2023, Tbilisi, Georgia. www.datafest.ge
5. M. Kublashvili, **Z. Sanikidze, T. Saghinadze**, M. Kublashvili. On the Mathematical Aspects of the Numerical Calculation of Engineering Constructions Weakened by Cracks. Second CERN-GTU collaboration meeting PMBC2023, 6 – 10 November 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
6. M. Zakradze, **Z. Tabagari**. Numerical analysis of some problems related to the calculation of electrostatic fields. Second CERN-GTU collaboration meeting PMBC2023, 6 – 10 November 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
7. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On One Connection Between the Moments of Random Variables. Computer Science and Information Technologies CSIT 2023, September 25 - 30, 2023, Yerevan, Armenia. https://www.csit.am/2023/schedule.php
8. **Kachiashvili K., Kachiashvili J., Kalandadze R., Kvaratskhelia V**. Automatic Diagnosis of Lung Disease on the Basis of an X-Ray Images of a Patient with Given Reliability. XIII International Conference of the Georgian Mathematical Union, Batumi, September 4-9, 2023. p. 140. http://gmu.gtu.ge/conferences/wp-content/uploads/2023/09/Conference_GMU_2023_01.09.pdf
9. **Kachiashvili K., Kachiashvili J., Kalandadze R., Kvaratskhelia V**. Automatic Diagnosis of Diseases on the Basis of an Irradiation Images of a Patient with Restrictions Both Type of Errors. The 4th International Conference on Modern Management based on Big Data (MMBD2023), August 1-4, 2023, Seoul, South Korea. p. 19 http://www.mmbdconf.org/
10. **Kachiashvili K., Kachiashvili J., Kalandadze R., Kvaratskhelia V**. The automatization of the medical diagnosis on the basis of an X-ray image of a patient with the restrictions of both possible errors on the desired levels. The International Conference "Distributed Computing and Grid Technologies in Science and Education", 3-7 July, 2023, Dubna, Russia. JINR Meshcheryakov Laboratory of Information Technologies. https://indico.jinr.ru/event/3505/attachments/16120/27954/program_GRID2023.pdf
11. **G. Giorgobiani**, G. Chelidze, V. Tarieladze. Rearrangement universality of the Dirichlet type series in a complex field. 14th ISAAC Congress. Ribeirão Preto, University of Sao Paulo, Brazil, 17 – 21 July 2023. https://dcm.ffclrp.usp.br/isaac/abstracts.pdf
12. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On One Connection Between the Moments of Random Variables. Int. Conf. Applications of Stochastic Processes and Mathematical Statistics to Financial Economics and Social Sciences. November 15 –16, 2023, Tbilisi, Georgia

13. **V. Kvaratskhelia, G. Giorgobiani,** V. Tarieladze. Subgaussian Random Elements in Infinite Dimensional Spaces. XIII International Conference of the Georgian Mathematical Union. September 4 – 9, 2023, Batumi, Georgia. Book of Abstracts, p. 116.
http://gmu.gtu.ge/conferences/wp-content/uploads/2023/10/Conference_GMU_2023_7.10_last.pdf
14. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On One Connection Between the Moments of Random Variables. Ninth International Conference on Statistics for Twenty-first Century - 2023 (ICSTC-2023). 15-18 December 2023, Kerala University, India.
https://sites.google.com/view/icstc2023/home
15. **V. Kvaratskhelia, G. Giorgobiani,** V. Tarieladze. Subgaussian Random Elements in Infinite Dimensional Spaces. The Fourth International Conference "Modern Problems in Applied Mathematics" dedicated to the 105th Anniversary of I. Javakhishvili Tbilisi State University (TSU) & 55th Anniversary of I. Vekua Institute of Applied Mathematics (VIAM). September 13-15, 2023, Tbilisi, Georgia.
16. **S. Katamadze, T. Tsmindashvili, N. Kukhilava, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth**. Enhancing Emotion Recognition: EEG Evaluation and AI Models. Online I En, Data Zen Community. December 20, 2023, Tbilisi, Georgia. https://wearecommunity.io/events/enhancing-emotion-recognition-eeg-evaluation-and-ai-models
17. **S. Katamadze, T. Tsmindashvili, N. Kukhilava, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth**. Enhancing Emotion Recognition: EEG Evaluation and AI Models. Online I Georgian language. March 22th, 2024, Tbilisi, Georgia. https://wearecommunity.io/events/enhancing-emotion-recognition-eeg-evaluation-and-ai-models-ge?utm_source=facebook&utm_medium=social&utm_campaign=ta?fbclid=IwAR0-mmpPbgQOhrvfV1T3y6awSz3Z9xFadOpKyYg0dS1k0M-rBYFcGai7cAM

Presentations at the First Summer School

1. Evaluation in EEG Emotion Recognition: State-of-the-Art Review and Unified Framework.
Sub-task 1: AI Technologies for Human Behavior Understanding, Emotions (face crop video, biosignals). Group 1: R. Kalandadze, N. Kukhilava, T. Tsmindashvili, S. Katamadze. Supervised by: F. Bremond, L. Ferrari (INRIA), P. Muller, B. Wirth (DFKI). Presented by R. Kalandadze and S. Katamadze.
2. The newest achievements of AI in Emotion Recognition from Human Body Movements. *Sub-task 2: AI Technologies for Human Behavior Understanding, Emotions (full body video)*
Group 2: I. Katchiasvhili, L. Tabagari. Supervised by: P. Muller, B. Wirth (DFKI). Presented by I. Kachashvili.
3. Exploring Image Captioning with Parameter-Efficient Transfer Learning for Vision Transformers. *Sub-task 3: Action detection/recognition (AI Technologies for Human Behavior Understanding). Group 3: T. Saghinadze. Supervised by: F. Bremond, T. Agraval (INRIA). Presented by T. Saghinadze.*
4. Georgian Pretrained Language Understanding Model. *Sub-task 5: AI Methods for Deep Speech Analysis in Health, NLP. Group: B. Mikaberidze, B. Tepnadze. Supervised by: P. Muller, H. Lindsay (DFKI). Presented by B. Mikaberidze.*
5. Studying neural correlates of speech production using fMRI and NLP. *Sub-task 6: AI Methods for Deep Speech Analysis in Health - NLP-fMRI. Group 6: T. Giorgobiani, S. Tsagareishvili. Supervised by: P. Muller, H. Lindsay, B. Wirth (DFKI). Presented by T. Giorgobiani.*

List of conferences and seminars organized at MICM

1. *2022, December 21 – Scientific conference dedicated to the academician N. Vakhania.*
2. *2023, 14 February – Seminar "About Lothar Collatz (3n+1) problem". Speaker Dr. T. Jaoshvili.*
3. *2023, 21 February – Seminar "Universality of Rademacher series". Speaker Prof. S. Tetunashvili (GTU).*
4. *2023, 21 March – Seminar "Convergence and divergence of Fourier series with respect to the systems of compact group characters". Speaker Prof. G. Oniani (Kutaisi State University).*
5. *2023, 28 March – Seminar "Necessary and sufficient conditions of existence of a singular integral with Cauchy kernel. Speaker Dr. I. Machavariani.*

6. *2023, June 27 – Seminar "Real-time decision support with distributed contextual intelligence". Speaker Professor of Distributed Systems & Security at Deakin University, Melbourne, Australia, A. Zaslavky.*
7. *2023, December 5 – Seminar "The Set Ordering Method for Scoring the Outcomes of Testing in Computerized Adaptive Testing". Speaker Dr. S. Razmadze.*

Table 1. Institutional KPIs of MICM (April 2024)

Number	Key Performance Indicators	Target for the end of project	Current
Scientific performance			
1	Number of peer reviewed publications	25	31
2	Number of peer-viewed publications per researcher	1	1.1
3	Number of presentations at scientific conferences	30	45
4	Number of publications/presentations co-authored by young researchers	40	12
5	Number of scientific conferences, workshops, symposia organized	10	7
6	Number of MSc and PhD dissertations defended	5/3	N/A yet
7	Number of researchers affiliated with the Joint Virtual Laboratory	25	N/A yet
8	Number of international project proposals submitted/accepted	10/3	1/0
9	Combined h-index of MICM researchers (sum)	40	h=80 Scopus, h=148 google sch.
10	Average "time-to-depreciation" of the MICM research equipment	30 months	36
Innovation performance			
1	Number of patents (by category: world-wide, European, national) granted	1/1/3	N/A yet
2	Number of other IPRs protected (copyright, industrial design, etc.)	3	N/A yet
3	Number of spin-off companies established	1	N/A yet
4	Number of knowledge transfer agreements and other types of licenses provided	3	N/A yet
5	Number of new products/services based on research results brought to the market	3	N/A yet
Economic performance			
1	Volume of the research budget (annual)	0,7 MEuro	0.242 MEuro
2	Share of competitive funding in the research budget	50%	N/A yet
3	Share of non-governmental funding in the research budget	10%	N/A yet
4	Share of international project funding in the research budget	30%	31%
5	Volume of funding accumulated in Joint Virtual Laboratory thanks to GAIN	150,000 euro	N/A yet
6	Return on Investments (through equity in spin-off companies, licensing, etc.)	10,000 euro	N/A yet
7	Research budget per researcher	15,000 Euro	3,000 Euro
Human Capital			
1	Percentage of staff members with doctoral degrees	60%	80%
2	Average age of research staff	45	60
3	Age balance (percentage of researchers in age groups)	40% under 40	24%
4	Percentage of women in research staff	30%	16%
5	Percentage of staff members acquired new skills	75%	37%