

# Remote International Collaboration in Scientific Research Teams for Technology Development

## An Exploration of Team Culture and Efficiency

Sarah Janböcke<sup>1</sup>, Toshimi Ogawa<sup>2</sup>, Koki Kobayashi<sup>3</sup>

Ryan Browne<sup>4</sup>, Yasuki Taki<sup>5</sup>, Rainer Wieching<sup>6</sup>, Johanna Langendorf<sup>7</sup>

SARAH JANBÖCKE ODR GmbH on behalf of Tohoku University, 45219 Essen, Germany<sup>1</sup>  
Smart-Aging Research Center (S.A.R.C.), Tohoku University, Sendai 980-8575, Japan<sup>2,3,4,5</sup>  
Business Informatics and New Media, University of Siegen, 57072 Siegen, Germany<sup>6,7</sup>

**Abstract**—Scientific research teams often find themselves in remote working situations due to their internationality. Incredibly complex technological projects demand close collaboration and knowledge-sharing management. Remote teamwork, especially in cutting-edge scientific technology development, comes with various challenges that can negatively influence the overall team performance and commitment to the project. Within the EU-Japan (EU-/MIC-funded) project e-VITA, a consortium of 22 multidisciplinary partners and around 80 people work on research regarding a virtual assistant for healthy and active aging. We conducted qualitative data within the consortium after nine months of teamwork to understand the influence of collaboration on commitment, personal performance, efficiency, and work outcome. Based on this research's outcome, we built a framework for future scientific research projects and consortia to increase efficiency and quality of teamwork, thus researchers' well-being.

**Keywords**—Teamwork; technology development; international collaboration; scientific team performance; potential technology leverage; scientific commitment; team efficiency; team commitment; team performance; collaboration

### I. INTRODUCTION

Project e-VITA, e-VITA Virtual Coach for Smart Aging, is an EU-Japan project under the EU Horizon 2020 program and MIC funding regarding the Japanese Society 5.0 movement. 22 international partners research from 2021 to 2023 regarding new technologies and methods to help an aging society deal with specific problems of their older people. The aim is to combine sociological, medical, and technological excellence to produce an innovative coaching system based on the needs of older autonomous living adults. Thus, a virtual coaching system that can provide personalized recommendations and everyday help improve older adults' life quality in Europe and Japan while also delivering opportunities to SMEs and NGOs to derive knowledge, services, and products from this joint research force. The aimed impact scale is wide-ranged and ambitious for all partners and stakeholders in project e-VITA [1]. Thus, this project is a rare opportunity to research specific factors of scientific teamwork in complex technological research consortia, especially under the influence of the COVID pandemic and its specific influence on remote teamwork.

Team-wise we face a relatively rare challenge in project e-VITA. The team is brought together from different backgrounds without being orchestrated like an average team in, e.g., industry. There is no existing team that seeks an extension with a hiring process. The group is teamed together from various organizations and needs to get along no matter what; and it is faced with high expectations from the grant giver [2]. Building a team spirit in remote teams with no touching points is a rare situation [3]. A considerable challenge is establishing self-organizing sub-teams within the whole group [4]. The project e-VITA members come from a culture of waterfall hierarchy [5] and non-self-reliant work that needed to be changed to become a self-organizing team structure with agile aspects [4] to reach the complex aim of the project. When working in industry, we find a relatively clear understanding of the company, product, and job. In a research project like project e-VITA, the project start presents like a start-up without clear organizational structures [6] but also without a concrete product to gather around. It is a rather vague idea of what the research should look like compared to what a start-up business plan looks like when facing investors [7]. Installing rather formal business and strategy documents like an innovation roadmap [8], charter documents [9], and communicational guides were the first steps to meet the upcoming challenges in such a setting. The installment of a technological platform for data exchange, meeting organization, calendar set-up, and workstream organization in a remote setting [10] was also organized within the team and its members. Furthermore, the project e-VITA consortium coordinators tried to set up clear work structures [11] comparable to organizational structures in companies that were supposed to lead to more success without the expected friction losses in traditional and complex research projects [12] in science.

This research aims to collect data about the experienced work setting and culture significantly different from joint research projects. In the very first step, it is not the aim to quantitatively evaluate the used tools but to qualitatively get an impression on the work experience [13]. Positive work experiences are linked with employees' positive three-layered work commitment [14]. Furthermore, a high commitment is linked to more efficiency and qualitatively higher work outcomes [15]. Apart from wellbeing and health benefits due to a positive work and team culture [16], we aim to deeper

understand influencing factors and work on a recommendation framework for future research projects with similar complexity. Thus, our research approach is to understand which factors influence international collaboration and teamwork, if the experienced environment and climate influence the individual commitment and the quality of work outcomes, and which specific factors influence the personal performance.

## II. METHODOLOGICAL APPROACH

### A. Episodic Narrative Interview

We conducted 12 episodic narrative interviews with project e-VITA consortia members. The aim of an episodic narrative interview [17] is to better understand a phenomenon by generating individual stories of experience about that phenomenon. An episodic narrative interview participant provides nested narrative accounts of their experiences with a social phenomenon within the context of a bounded situation or episode. The episodic narrative interview is made to generate tightly focused, phenomenon-centered narratives reflective of bounded circumstances. We aimed to explore the deeper levels of experience linked to commitment and its effects and avoid the validity threat of social desirability by using a method that leads the interviewees to intuitive ways of reporting, in contrast, to merely answering explicit questions. We thoroughly followed the steps as presented by Alison Mueller.

### B. Interviews

We interviewed members that had to fulfill the delimitation criteria [17] of being part of the consortium for the whole period of nine months of bringing experiences from other research projects/ consortia, and of being actively involved in the project e-VITA in the specific episode in contrast to being a silent member that becomes active in later stages of the project. Furthermore, the sample was equally mixed from members of the EU and Japanese sides of the project. Thus, the primary interview language was English. To overcome possible language barriers, we also conducted five interviews in Japanese and professionally translated them to English for analysis purposes. The interviews were conducted remotely via Zoom without video streaming.

The 12 interviewees (Table I) were between 33 and 60 years old, with an average age of 46 years. Amongst the interviewees, we found six senior researchers from industry and science, four university professors, and two persons with high-ranking industry jobs (CEO/CTO). All interviewees have leadership experience ranging from 1 to 100 reports in technology science and industry, medical service and science, the housing industry, and political consultancy. Work experience ranged from 5 to 32 years at the interviews. All interviewees have a middle to high involvement in the researched project of project e-VITA.

### C. Analysis Process

As the method of Episodic Narrative Interview by Alison Mueller is relatively new and innovative, it does not offer extensive guidance regarding the used and proven analysis steps. We thus chose to be guided by the ideas of Grounded Theory Analysis and to follow the suggested three coding steps of open coding, axial coding, and selective coding to steadily

re-compare data and found phenomena to, in the end, derive a theoretical framework for the research questions of interest [18].

After the interviews were numerically coded to preserve anonymity, we mixed the Japanese and EU data by changing the numerical order to ensure an analyzing process without intercultural presumptions. We used five W-questions within the first coding step to define meaningful passages within the interviews and for the first theoretical abstraction. We focused on what was said, who was involved, what aspects were essential or influencing, why they were essential, and what solution was chosen for specific situations or problems. Thus, the aim was to detach the relevant passages from the overall interview to get an accurate impression of meaningful aspects not only in the context of one interview but in relation to the other interviews and relevant passages within.

Subsequently, we axially coded the defined text passages. We used the same codes to find connections, similarities, and differences. In an additional step of axial coding, we reduced our code system to capture different perspectives on particular issues. In a last coding step of selective coding, we started condensing our code system into a category network based on the found core categories from our previous coding steps.

We now were able to form theories and connections within a framework that could be the base for better cooperation in future international research projects.

TABLE I. INTERVIEWEE CHARACTERISTICS IN RANDOM ORDER FOR ANONYMITY, OWN DESIGN

Age	Position	Branch	Reporting Employees	Years of experience in expertise field
55	Senior Researcher	Real Estate Development	4	10
43	Senior Researcher	Research Institute	1-10	10
60	Professor	University	20-100	25
42	Senior Researcher	University	100	8
40	Assistant Professor	University	10	10
60	Professor	University	10-12	32
50	Manager	Start-Up	4	20
56	Senior Researcher	Research Institute	1	31
35	Senior Project Officer	Research Institute	1	5
39	Senior Researcher, Project Manager	Research Institute	2- 6	15
37	CTO	Start-Up/ Research Institute	4	14
33	Assistant Professor	University	7	4

#### D. Validity Threats / Methodological Limitations

The researchers of this study are part of the research object project e-VITA, i.e., potentially part of the phenomenon. This bears the danger of participant-answers according to the considerations of social desirability. We addressed this validity threat to meet the quality criteria by involving a supervision process to exclude the researchers own relevance system [19] from the data conduction and analysis phase during the research process, by using different interviewers, not only to meet language requirements and challenges but also to balance the personal factors that could arise social desirability answers. We focused on making the interviewees feel most comfortable to freely describe their experience with the phenomenon of interest. The validity threat of social desirability during the data conduction phase was also addressed by avoiding the video call and using a neutral screen whilst conducting the interview. Furthermore, we deliberately used the narrative interview style to lead the interviewees into phases of free talking and reminiscence without considering the interviewer and their relationship to each other [17] thus avoiding effects of social acceptance validity threats.

To distance ourselves from our own relevance system [19] during the analysis, we chose to present the data to a third-party researcher that was not involved in the project e-VITA so far, nor in planning the presented study or in conducting the data. The aim was to involve a perspective that adds an outer view on the data and results to avoid super exceeding expectations within the analysis [20] and research project of this study.

We considered a translator effect as another possible challenge [21] that we met by using the native language speaker on the JP side for data conduction. For the EU side we only used English as a common language for the interviews. We ruled out most of the common translator threats by using an algorithm-based translator software and a person fluent in both languages JP and English that professionally supported the study in the translation process.

### III. RESULTS

Within the following section we will present the found phenomena and directly compare them to the adjoining theoretical base. As no directly linked research can be found so far for our specific research questions in this application field, we draw links between adjoining fields and transfer them to our specific application interest. We combine the two steps of theoretical background/ comparison and result presentation for the sake of readability and length. We aimed our analysis to our above-mentioned research questions and could thus verify the following aspects as influencing factors for remote scientific work and international collaboration in research teams.

By the majority the interviewees addressed their need for change in various categories, but also their favor of certain aspects. Thus, we could define the topics communication, technical infrastructure/ remote work, organizational structure, personal information, cultural differences, commitment, workload, vision/ shared goal, personal development/ growth,

and shared values/ team cohesion as main categories for our analysis, i.e., most meaningful aspects for the interviewees.

The interviewees showed a great willingness to share deep insights of their experienced collaboration with us during the interviews. Throughout all interviews we could identify the most prominent topic, communication that was always addressed but was also always linked to all different categories mentioned above. Another specific phenomenon was the great wish to talk about commitment and to clarify specific forms of commitment throughout the whole consortium. The wish to enhance the organizational structure within huge projects like the researched one was also found in all interviews. Especially facing the affecting factors due to the COVID pandemic situation and remote working aspects left the interviewees with many expressed challenges.

#### A. Commitment / Shared Vision

Overall, respondents felt a strong commitment (compare [14], [15]) to the project and were motivated to achieve a good result. Especially the shared vision and shared common goal were named as important aspects to tackle the high complexity and workload of the project. However, many interviewees expressed the need to give more focus on a common vision and its communication within the whole team and to external partners and media streams.

“I think the positive thing is that we are very, very committed. So that's very new for me. And despite the fact we can't meet in the European countries or in Japan. ... Really, thanks to all the partners and namely the work coordinators, which are very, very involved and committed in this project, I think it is, this is also the guarantee of our success.” (Interviewee 6).

“I think that there is an overall goal in this project and that their people are working to, uhh, a lot of people working together on one goal with a certain amount of honesty and endurance and competence.” (Interviewee 2).

“...it would be good to find ways to at least in the beginning, to insist on this kind of vision.” (Interviewee 11).

The interviewees showed a solid normative and continuous commitment [14] when expressing the need to fulfill expectations to grant givers. Interestingly, they wished for more opportunities to expand their affective commitment [22] by getting deeper into the project's shared visions and getting deeply involved with their teammates throughout the whole consortium. Though all consortium members stemmed from different 'home' organizations and planned to build a research project like common in their field of work, they showed a strong interest in building an own organization for the project e-VITA. The tendency to form an own organization with all its effects like being committed to “one brand” gives a useful indication to the later framework but also to motivational aspects that can enhance innovative behavior for consortium members [7], [15], [23], [24].

#### B. Workload

The interviewees criticized the fact that they felt to only work for the deliverables of the project contract rather than the physical result, which aligns with the finding of a high

normative commitment mentioned above [25]. This sometimes put them under pressure and made them feel that the already high workload was even more significant or not feasible; they felt overwhelmed not capable of managing their own and other expectations. Thus, the interviewees expressed a decreased innovative capability aligned with first burnout tendencies [26]–[28].

In addition, some interviewees commented that they did not have the time to read through all the parts of the reports, even though they were interested in the progress of the other teams. The feeling of not being fully part of the team due to lacking information led the interviewees to want to enhance communication streams for deeper project involvement. This aligns with the wish to feel affectively committed [14], [22] to the project and gain a deeper understanding for the whole organization as well as the wish to be part of a 'bigger thing' to enhance self-efficacy [29], [30].

They also felt that the regular meetings of all the teams were too long and not very profitable because often everyone only gave their presentation, and there was barely any time for discussion and exchange. Thus, we can detect the need to deeper identify the leadership style and team cultural desires that are applied to the project. Discussion satisfaction among consortium members is a leading force in innovation behavior and employee satisfaction, furthermore a specific challenge in virtual teams [31].

The interviewees felt essential communication was missing; they expressed the need for an enhanced communication structure to cover specific information needs.

“...my first impression of this project for the initial months is that it has been very hard to do.” (Interviewee 4).

“(Person’s name) is struggling with a lot of deliverable workload.” (Interviewee 1).

“I’m sure it must be very difficult for the other researchers who are also working on top.

of their own jobs.” (Interviewee 3).

“I felt like I had to give 200% or 300% to finally I felt that ummm I was finally able to get an answer and wondered if I only resolved the issue because I had gone that far.” (Interviewee 1).

“I wish that days were 40, 48 hours long, but unfortunately they are not.” (Interviewee 5).

### C. Team Communication / Shared Goal

Some interviewees criticized that each team worked on its own and that there was too little collaboration as a whole group. As a result, a lot of knowledge was lost, even though the interviewees were basically interested in a team-wide overview.

“But the fact that we are working in silos we are working individually is not helping.” (Interviewee 9).

“But if we think that we need to cooperate, I found it really difficult to identify a cooperation with them.” (Interviewee 12).

“My impression is, that we haven't yet reached the point of real collaboration, which will become necessary in the future as we implement the system.” (Interviewee 7).

“Some do not work together at all. They don't know what. So European people do not know what the Japanese people do and the other way around...” (Interviewee 2).

In addition, each team within the consortium had different ways of working, so that it was difficult for non-team members to understand how the others worked and what insights could be gained.

“...it was always a bit of a feeling of not knowing what's going to happen next. All people on the same boat, so it was a bit like a kindergarten teacher to, uh, yeah, to, to take care of all the people involved in this project, are they all there? Are they going to be in the meeting? Are they doing their homework, so to speak?...” (Interviewee 2).

Again, we identify the consortium members' wish to be fully bound to the project, the desire to be given a broader base for their affective commitment. Obviously, this wish is connected to efficiency optimization but also to creating a work environment that offers wellbeing aspects [11], [22], [29], [32].

### D. Team Cohesion

The interviewees expressed a strong wish to feel as a whole and powerful team. They expressed the desire to be part of a big group capable of stemming this high workload and high complexity of such a technological research project. This is in alignment with the finding that the interviewees expressed the desire to find an environment that gives plenty of room for affective commitment in a work and research field that normally is rather conservative compared to brands that are classically connected to affective commitment like Adidas, Nike, Google, Apple etc. Interestingly the wish could be found without a cultural difference [33], [34].

“... a strong team is necessary, I think, to face the workload of project e-VITA.” (Interviewee 9).

“It's the team spirit. Yes, it's the team spirit and the team.” (Interviewee 6).

### E. Organizational Structure and Leadership

The interviewees wished for more apparent structures and task definitions, both within the team itself and across teams. They felt that time was lost, and the already significant amount of work was increased. More transparent structures would also enable more effective planning so that the workload and project flow could be managed continuously. This leads to the assumption to closely define work structures and streams in alignment with the team's socio-technical environment. This is true especially with regard to the used technological infrastructure that is applied to the project and the virtual team [35], [36].

“...a number of leaders and they all have a different way of a different style of leadership. Totally different. But there are a lot of people work with all of them or a couple of them, so they experience different ways of leadership, and some are more or less fair or more or less committed. Some are very committed.

So that's just a more heterogeneous way of leadership. And a lot of leaders next to each other.” (Interviewee 2).

“...if you're not involved as the leader. Because the project is so big and so many work packages are working next to each other simultaneously. You kind of get lost because you if you're not in every meeting that there is available, you will lose track of what's going on and other work packages. And therefore, you will not know what's going on there” (Interviewee 2).

“The needed structure to make all this thing run, um, well, of course, is necessary,…” (Interviewee 5).

“So, you have to do this strict organization, but also flexibility to change your objectives and your approach.” (Interviewee 10).

Some interviewees explained that they sometimes had too many tasks for which they lacked staff and skills. Hiring appropriate staff and giving room to these processes was expressed as a problem linked to the wish for enhanced organizational structures and better communication. Finding and keeping the right scientific personnel is well known as being a challenge. Especially the advanced skills needed in cutting edge technological projects demand a thorough selection process to ensure work quality results [37], [38]. Most managing persons in scientific projects were never trained in managing skills such as hiring and selection processes. These challenges were not mentioned but remained closely linked to this aspect. It is most likely that those persons demand a higher amount of time fulfilling the task of hiring than those who were specifically trained like industry managers and HR experts.

“Sometimes (team member’s name) would ask me in meetings what I thought, but I couldn't say much, and I was a bit muddled, and I really didn't feel I could say much, even though I was the leader of Work Package...” (Interviewee 1).

“To be honest, there are many areas that are not my area of expertise,…” (Interviewee 4).

“In terms of my work, I have to deal with areas that I don't have the knowledge or experience to deal with,…” (Interviewee 8).

“...and we actually ask a temporary worker to do it for us.” (Interviewee 1).

“I think we need to ask a specialist for that, and we need to ask someone to support us in that area in the future.” (Interviewee 3).

We could also identify the wish to find a defined leadership style based on the findings. Interviewees described the current style and their wishes not only in terms of leadership in the project that defines certain tasks and work structures but also in motivation and guidance through the project's complexity. Thus, we can conclude the need to research appropriate leadership styles like transactional, transformational [39], or servant leadership [40] and follow basic principles based on the individual necessity of the team and project requirements (compare also [31]).

## F. Remote Work / Technical Infrastructure

The ongoing COVID pandemic intensified many of the problems, as people could only work remotely with each other, which, on the other hand, is valid for many international projects even without the pandemic ongoing. This meant that the individual component was lost entirely for some interviewees because the international meetings could only take place online. They explained that as a result, they could not get to know their colleagues at all or only to a much lesser extent so that many aspects of communication such as facial expressions or the individual personality could not be conveyed. At the same time, a good team and support in the team were named several times as essential motivators to withstand these critical working conditions [7], [36], [41]. On the other hand, the remote work increased the wish to find enhanced organizational and communicational structures. The interviewees expressed several times the need to restructure classical work processes due to increased communication and alignment times to ensure efficient remote work [36], [42].

Furthermore, the interviewees described the wish for skilled personnel that deals with technical infrastructural questions that, on top of their research workload, needed to be tackled by themselves without the according expertise to do so. The remote working situation longed for specific technical solutions to ensure an efficient workflow, data exchange, video meetings, and a secure working environment for sensible information. According to the interviewees, the existing solutions on the market were not made for the specific context of scientific research projects, which left the members with many open issues that hindered their research work and work environment.

“I will say this is the first time that we are doing all the coordination in such a huge project, all by remote.” (Interviewee 5).

“...we didn't meet each other face to face also didn't help.” (Interviewee 9).

“I think it's something important. That the human interaction is it's important for the collaboration, for the cooperation and so on.” (Interviewee 9).

“...we never met face to face. And we could see that the...umm. It took more time, let's say to, to adjust our... there's an expression in xxx (my language) saying that we..., meaning that we have to adjust to the other person.” (Interviewee 9).

“...discovering that we can have a productive and efficient collaboration purely online was also quite a good thing.” (Interviewee 11).

“I also appreciate it a lot the selflessness in the Japanese partners in helping us...” (Interviewee 5).

“I really see a mutual help in this collaboration.” (Interviewee 10).

## G. Cultural Differences / Personal Information and Development

The cultural differences between the teams were on the one hand seen as enrichment, but at the same time also led to some misunderstandings and problems, especially between the

European and the Japanese team. Since communication differs in many ways in all involved cultures, everyone had to adjust to each other first, which cost a lot of time that was not given within the planning structure. However, these misunderstandings could partly be solved through communication by individual team members explaining their behavior afterwards, thus creating an understanding. Again, this phenomenon is strongly linked to the expressed wish to rethink organizational structures and different communication behavior [36], [42].

“I think throughout the first nine months, it also changed a bit from the Japanese side. So, in the end, in the beginning, they were less vocal about their needs and also about their limitations. Now they are more vocal about it. So, they sometimes say they, I'm just referring to specific institutions I had contact with. ... I'm sorry, I don't know anything about it. Someone else has to do it. ... From my side point of view, they feel more comfortable to tell us if something is just not possible for them with regards to schedule, competence, or anything like that.” (Interviewee 2).

“... this kind of approach is something that has never been seen before in Japan, especially in technical projects...” (Interviewee 8).

“Challenges also is that we come from a different cultural context. ... But I feel like it's a cultural thing in Japan. Maybe I am not sure. Maybe they need more time to get the approval of maybe the hierarchy.” (Interviewee 9).

“...first difficulty was to try to understand each other, especially with our Japanese counterpart, because there were some small difficulties at the beginning and understanding each other.” (Interviewee 10).

“...it's not the same with the Japanese partner. Sometimes I think that the communication channels, it's completely different between us and them...” (Interviewee 12).

“There are three or four different European cultures that are packed together and in one side of the project, I would say, and it felt like the Japanese were between themselves, more in line with what they were doing then than the European side.” (Interviewee 11).

“That experience itself is something that I had never experienced before in my involvement with domestic projects in Japan. ... it was the first time that I had actually experienced this kind of emphasis in a project, and I think it was a great experience for me to be exposed to the values of this kind of team.” (Interviewee 8).

“I also started to understand how people work in such a mixed project and their habits.” (Interviewee 7).

As mentioned above, it was often expressed that more effective communication was desired. Particularly through remote work, some of the interviewees felt that communication was essential to create a team feeling, get to know each other and work effectively together. According to some of the interviewees, work-related conversations should occur more often and be shorter. On the other hand, the personal component should be strengthened by creating a framework for conversations without a work-related context. This aligns with

the idea to find an environment that leaves more room for affective commitment and its effects [43], [44].

“In the end, the only way to get along with a group of people who don't know each other is to talk to them. That's all there is to it.” (Interviewee 7).

“...it was really important to have these series of meetings and conferences. ... I think that this should be an added value for the future and which we will have more time and more space on board to talk together and to plan together. ... we really need to be in communication with more partners and also from the Japanese counterpart. That is something that we can do” (Interviewee 10).

“...because for myself, I think it's you can deal with everything if you talk about it. So, if somebody has someone has a hard time in his private life or I don't know and he can't do his parts at us, that's not a problem itself, because then just tell me and we can work around it.” (Interviewee 2).

Based on the various and extensive aspects that we gained throughout the interviews, we could identify two main pillars with a respective substructure that will be discussed in the following framework derivation section.

#### IV. FRAMEWORK DERIVATION

We derived a theoretical framework from the coded data and found the according information within the last step of theoretical abstraction. The framework will be a mixture of textual and visual overviews that shall aim to build recommendations to further contexts of remote scientific work.

We could identify two main pillars that headline the discussed categories – terms of commitment and organizational structure. Within standard research project organization, we find a discussion focus in research teams and their organizations on content-based aspects like research topic, research question, grant giver restrictions, deadlines, and deliverables (Fig. 1). Discussions around structural aspects and terms of commitment seem to be missing, which initiated the expressed need for change from the interviewees.

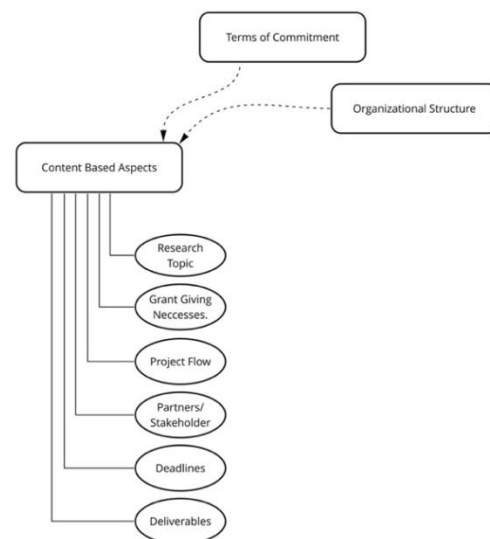


Fig. 1. Commonly Discussed Project Aspects and Missing Factors, Own Design.

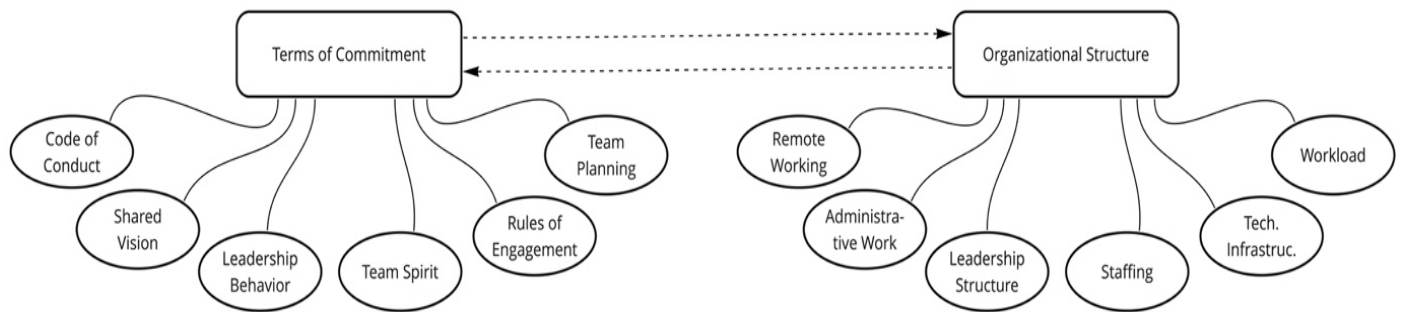


Fig. 2. Framework Extension Visualization, Own Design.

Triggered by the interview style, we could identify meaningful aspects that the interviewees either wished to be realized or intensified. We thus could build Fig. 2 from which we can derive questions that future research teams in similar working situations like project e-VITA should address before starting the project (Fig. 2).

Under Terms of Commitment, we could identify six subcategories addressed with the interviewees' wish of change.

- 1) Code of Conduct
- 2) Shared Vision
- 3) Leadership Behavior/ Responsibilities
- 4) Team Spirit
- 5) Communicational Engagement/ Rules of Engagement
- 6) Team Planning

For Organizational Structure, we could identify six further subcategories.

- 7) Remote Working Aspects
- 8) Administrative Work and Timing
- 9) Leadership Structure
- 10) Staffing Issues
- 11) Technological Infrastructure and Maintenance
- 12) Workload

We will now present the questions derived from the interview material, which should be addressed in advance before starting a research project within the whole consortium. Based on the defined categories, the interviewees described meaningful aspects and questions, topics, and problems they favor to be addressed. We summarize those as follows.

1) Code of conduct / Shared values

a) How do we want to deal with competition? Knowledge-sharing?

b) To which extent do we integrate cultural differences as a beneficiary factor? Or do we just ignore them? Will we use them as learning aspect for personal development? Do we explicitly address them before or while working?

c) How do we deal with motivational aspects? Who is responsible for motivating the team, each one on his/her own or the consortium leader? How do we deal with missing motivation?

2) Shared vision

a) Which goals can we identify? Is it one goal for all, or can we combine various goals? Are there individual goals that are hard to integrate into the whole project? What do we want to achieve after our joint project time? Which result do we want to see in the end?

b) Is there any sort of a "brand message" that we can describe for our project, may be based on its name? For example: xxx (name of the project) stands for...

3) Leadership behavior/ Responsibilities

a) Do we have a leadership structure that can be clearly defined? Which responsibilities do we see for our possible leadership? Can we share responsibilities and leadership workload?

b) Which leadership style do we want to apply?

c) Who is filling the roles that we defined for our leadership?

4) Team spirit

a) How do we plan to work together? Do we see the project as a joint project by people from various organizations that meet every now and then? Do we want to build our own very close team, like our own little organization?

b) Can we all commit to the shared team spirit goals? How do we deal if individual positions do not align with our overall team spirit goal?

5) Communicational engagement

a) Can we define communicational rules? Which will be essential to us?

b) Which communication channels do we want to use? Chat, Mail, Telephone etc.

c) Can we define reaction times to different communicational media streams like WhatsApp, Mail, Chat, Kanban boards, phone calls, ToDo lists etc.?

d) Can we rate the consequences of chosen communication media streams? Can we use them and commit to our communicational rules and reaction times?

e) Can we define a timing range and content that needs to be discussed regularly? How often? When?

6) Team planning

a) Do we want to be one team or act in specific silos? Do we want to experience the benefits of getting to know researchers with diverse backgrounds, and how do we manage

this? How can we benefit from diverse backgrounds and integrate them?

b) How much time do we plan to set up and proceed with team planning sessions?

c) How do we deal with positions that do not align with our overall goal regarding team planning sessions?

7) *Remote working aspects*

a) Which experiences do we have with working exclusively remote? Which aspects of teamwork are essential and need to be included in the project?

b) Which benefits can we identify, which challenges? Which differences in contrast to face-to-face work do we need to consider?

c) Do we plan additional time to tackle the identified challenges?

d) How do we deal with missing answers to possible upcoming challenges?

e) How do we deal with knowledge/ result sharing aspects throughout the internal teams? How can we tackle information overflow vs. missing information? How do we share results, papers other information in a manageable way?

8) *Administrative work and timing*

a) How much administrative work do we expect from this project?

b) Which experience from previous projects can we share? Are they beneficial to our situation now?

c) Can we plan additional time for administrative work?

d) Who will be responsible for tackling administrative issues? Who is in charge, and can we delegate tasks?

9) *Leadership structure*

a) Can we define the leadership structure that we previously discussed in question 3a?

b) Can we sketch the leadership structure in one organigram that will be mandatory for all members?

c) How do we deal with changes in our project structure and according responsibilities?

d) How do we deal with missing commitment?

10) *Staffing issues*

a) Do we have the needed competencies already onboard, or do we need to expand?

b) Did we plan enough time to find the fitting team extensions and competencies?

c) How do we deal with missing competencies? How do we close possible gaps?

11) *Technological infrastructure and maintenance*

a) Which technical infrastructure do we want to use to work remotely? Which technological solution/ platform for which task discussed in 5b+c?

b) Which experiences can we share from other projects?

c) Who is responsible for setting up the technical infrastructure?

d) Who will maintain the chosen solution throughout the whole project, and do we have, or these persons have enough resources for fulfilling their task?

12) *Workload*

a) Did we realistically estimate the upcoming workload?

b) Can we identify gaps, challenges, overloads? How do we handle them?

c) Did we realistically plan the necessary time to tackle our workload? If not, how do we deal with upcoming problems?

d) How do we deal with various positions about workload manageability? Especially about aspects discussed in 1c?

Based on our findings we argue that beside content-based aspects future scientific research projects especially in remote working situations should address Terms of Commitment and Organizational Structure aspects to ensure efficiency, optimal team performance and researchers' wellbeing and commitment to the project. All three will be decisive for the later project's result and should stand equally beside each other in terms of importance (Fig. 3). This equality can be derived from our interview data. Thus, our orientation framework is of interest for future teams and grant giving stakeholders that review and proof project proposals, project flows, and results.

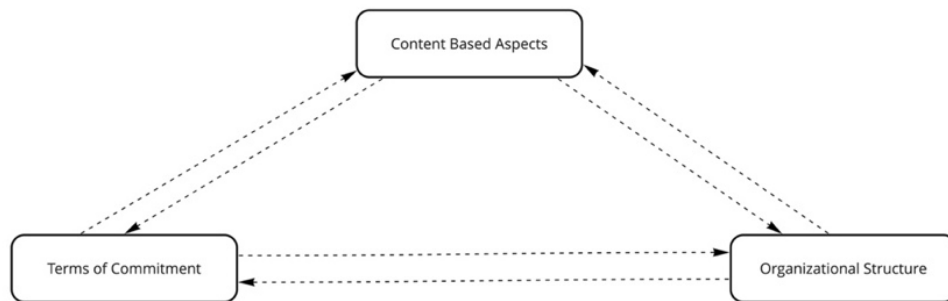


Fig. 3. General Framework Overview, Own Design.



## V. DISCUSSION

The presented study shows the need for additional planning when orchestrating a research project, especially in remote scientific, international collaboration. The high complexity of cutting-edge technological research projects is an additional complicating factor for the work environment. Based on the conducted data, we could show that the need to introduce additional aspects apart from content-based discussions is strongly given. Doing so will most likely positively influence team commitment and thus personal and team performance, efficiency, and work quality.

### A. Affective Commitment

International remote collaboration seems to be determined by many more soft factors than considered when planning projects. However, the team and individual performance can be positively influenced by the conscious planning of the soft framework factors. The possibility of living affective commitment in the projects is closely related to increased efficiency [45], [46]. In contrast to normative and continuous commitment, affective commitment is known to cause performance to skyrocket. A factor that should not be neglected in difficult working conditions such as remote work. A variety of framework conditions give the possibility of being able to form affective commitment. The interviewees described which organizational-psychological measures can be taken to bond emotionally to the project and thus create an environment of well-being. The sub-items of the found Terms of Commitment and the items of Organizational Structure are therefore sub-areas of the overall measure to create an environment for affective commitment. Employee commitment is widely researched for companies and their working environments.

In connection with employee identification, employee retention, and performance improvement, commitment is essential for regulating personnel processes. Organizational commitment, in general, is known as a critical driver to motivation and performance improvement of employees. However, it is advisable to distinguish the specific forms of commitment to deeply understand the influencing factors [46]. Continuous commitment is based on employees' cost-benefit calculation, i.e., leaving the company is associated with economic disadvantages for an individual that exceed the leaving benefit, a bond is created, and the employee tends to remain in the company. In contrast, normative commitment is based on an individual's values and perceived moral obligation to remain loyal to his or her company. The employee might feel committed to the company due to favors his/her superior might have given him/her in the past. On the other hand, affective commitment is defined by Meyer and Allen as a solid psychological bond that ties the individual to the organization. It describes the emotional attachment to the organization and has its origin in positive experiences with the company [47]. Affective commitment is declared to be the most potent form of employee loyalty to the organization and is not moderated by cultural country specifics [48]. A high level of affective commitment is associated with increased motivation, the will to take additional tasks, and employees' feelings of joy and pride for their organizational affiliation. Thus, affective

commitment correlates positively with higher individual performance and efficiency [49].

The found sub-items of our two main pillars, Terms of Commitment and Organizational Structure, describe with high agreement what organizational commitment research suggests applying for employee commitment improvement. Without explicitly knowing and naming aspects of what organizational research has known for decades, the interviewees described them for an entirely different setting. We argue that transferring organizational knowledge in the form of our framework to scientific research projects will increase affective commitment for remote researchers and the academic world and thus performance, efficiency, and researchers' well-being.

### B. Limitations

As discussed in the methodical section, we thoroughly tried to rule out possible limitations to the methodological approach. However, we cannot exclude the possibility that we did not get the full emotional range from the interviewees based on their cultural background or other personal influencing factors. This might give room for the fact that we did not record specific problems to the same extent as those mentioned by the persons who talked utmost limitation-free. However, this is true for every qualitative study since the researcher can never be entirely sure if the interviewees provide their whole knowledge or feelings. We thus trust our interviewees' expertise and professionalism, thus their given insight.

We mixed insights from university employees with those working in the industry. We deliberately did not separate those two sectors to gain a broad overview of multidisciplinary project structures in which industry and science mix. Knowing that the used work environment and standards most likely differ from science to industry, we consider a mixed sample approach as the most realistic one when seeking a framework for projects that combine science and industry partners most of the time.

Since we conducted data in Japan and Europe, specifically Germany, France, Italy, and Belgium, we cannot predict our conclusions transferability to other multi-cultural settings. However, some of the interviewees have extensive international experience, so we assume that the resulting framework can be adapted to other cultural standards and demands. We formulated the framework questions in an open manner that leaves enough room for individual cultural adaptations. Furthermore, since the suggested framework focusses mainly on increasing employees' affective commitment, we can also minimize the risk of cultural moderating factors [48].

We interviewed mainly persons with higher responsibility, i.e., higher hierarchical position. We cannot entirely be sure if the meaningful aspects found can be transferred to the emotional narratives of low-ranking employees. We considered the interviewed persons as experts for their field, including their lower-ranking staff. However, we cannot entirely rule out the difference in findings when replicating the study with a different sample and adapted delimitation criteria.

Deliberately we excluded researching the technological tools used and mentioned to ensure the technological infrastructure for remote work. This study focused on meaningful aspects to participants of remote international research projects, not on evaluating the technological solutions used.

### C. Future Studies

For the future, we see the open question of how the resulting framework described above can be implemented and used for prospective research projects. We see the danger that apart from focusing on the necessary content-based aspects, time is limited to concentrate on Terms of Commitment and Organizational Structure. Especially at the beginning of a project, when a consortium starts to find a joint base, additional time for such workshops might be missing or not considered relevant. After nine months of the project, the described challenges, obstacles, and problems are prominent for the interviewees. They might not have been prominent in the very beginning. However, since most partners in such projects come with experience from other research consortia, we can assume that the mere trigger to spend time on additional planning aside from the content-based aspects gives the suitable indication and priority. It might seem to add additional work at the beginning of a project. The possible reactance towards that must be overcome to later benefit from the positive effects of such a framework application. Especially the consortium leaders will oversee transporting the necessity and creating room for workshops, discussions, and fixation of framework questions like those mentioned above.

Next, we see a necessary evaluation of the framework. As a first step, we regard the opportunity to discuss the found framework and questions with experienced researchers and members from various projects and possibly adapt our recommendation according to those findings. A comparing evaluation might be possible for the far future, i.e., comparing projects and their results with and without applied framework.

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