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# Contents

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# 1.  Introduction and definition of interdisciplinarity

*From 2006 to 2018, the fraction of researchers who were cross–disciplinary increased from 17% to 26%.*

Please add a quote/footnote to the statement above

In recent decades, the concept of interdisciplinarity has become increasingly important in science. Consciously, but also unconsciously, it has penetrated the pores of scientific research as an independent form of scientific procedure. And yet, the popularity of the term has blurred the boundaries with related approaches, so that in practice it is often conflated with similar terms such as multidisciplinarity and transdisciplinarity. This is partly due to theoretical frameworks, particularly the different meanings of its integration (Richards, 1996, Klein, Newell, 1997, Haynes, 2002, Moran, 2002, Repko, 2007, Szostak, 2007).

Although the concept appeared much earlier, the frequency of using the interdisciplinary approach increased in the 1960s, mainly due to the need to gain new scientific knowledge and find practical solutions to complex problems that could not be solved through the prism of a single discipline (Toš, 2021, 67). This does not mean that we have to abandon disciplines as a concept; it simply reflects the need to create stronger connections between them. Basically, the concept of interdisciplinarity is closely related to academic disciplines. They are organizations of learning and systematic production of new knowledge (Krishnan, 2009, 9) that undergo processes of establishment, development, and transformation over time (Repko, 2008, 5). However, a one-sided approach limits them in solving complex problems that require the combination of different types of knowledge and the interplay of disciplines. On the other hand, different approaches do not harm the disciplines themselves, but provide a strong incentive for their progress or influence the creation of new disciplines (Wernli and Ohlmeyer, 2023). Many topics do not follow the boundaries of traditional academic disciplines, and the need to cross them has created various degrees of connections, from simple, natural, and logical connections to complex connections and the integration of disciplines that at first glance have few points of contact.

Multidisciplinarity is a scientific approach that refers to the confrontation of different disciplines between which there are tangible connections (Turudija, 1982, 34), through the joint presentation of the perspectives of different academic disciplines on a common topic. Individual disciplines with their specific methods and skills work on solving problems without changing information, ideas, techniques or methods (Toš, 2021, 69). Simply put, multidisciplinarity means the independent work of two or more different disciplines, with each discipline making its own contribution (Stokols et al., 2003; 2008, Razzaq et al., 2013, Salter and Hearn, 1996, Wall and Shankar, 2008). There is no real integration of disciplines, and the only connection is the common problem posed.

The growing need to integrate disciplines has led to an understanding of an interdisciplinary approach that adds scientific value to the disciplines involved (LERU, 2016). One of the most general interpretations states that interdisciplinarity is any form of dialogue and interaction between two or more disciplines (Moran, 2002, 16, Krishnan, 2009, 6) or a means of solving problems that cannot be addressed by a single approach (Klein, 1990, 196). Such definitions are certainly a bit too general, reducing or even completely rejecting the level of interconnection between disciplines (Repko, 2007, 1). According to Veronica Boix Mansilla (2005, 169) defines interdisciplinarity as "*the ability to integrate knowledge and ways of thinking from multiple disciplines with the goal of achieving cognitive progress, whether the goal is to explain a phenomenon, solve a problem, create a product, or ask a new question*" (Boix Mansilla,). The focus is on problems that are too broad or beyond the scope of a particular discipline or research group (see Klein and Newell, 1997, 393-394, National Academy, 2005, 39, Toš, 2021, 69). The fundamental determinant of the interdisciplinary approach is the integration of diverse information, data, techniques, perspectives, concepts, and theories with the goal of creating a common approach among opposing disciplinary views (Haynes, 2002, xii-xiii; Klein, 1996, 224, Repko, 2008 , 11, Stokols et al, 2003, Griffin et al, 2006 11, Dykes et al, 2009, 105; Wall and Shankar, 2008, 552). Interdisciplinarity draws knowledge from relevant disciplines and integrates it into a more comprehensive understanding (Newell, 2001, 2). Synthesis does not take place at the level of knowledge objects, but primarily at the level of concepts and methods, and even more so at the level of

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principles and axioms (Turudija, 1982, 34). Interdisciplinarity can take place within closely related disciplines (narrow interdisciplinarity) or within more separated disciplines (broad interdisciplinarity) (Wernli and Ohlmeyer, 2023). In both cases, a methodology is used that is not limited to a particular discipline and requires the use of the perspectives and skills of the disciplines involved at multiple stages of the research process (Villeneuve et al., 2020). In this way, the interdisciplinary approach creates new ways of working (Pirrie et al., 1998, Razzaq et al., 2013, 155). At the same time, it becomes a means of bringing science out of the realm of the abstract into the full complexity and specificity of the concrete (Hansson, 1999, 339). Interdisciplinarity requires problem-oriented critical thinking with an emphasis on process rather than scope (Youngblood, 2007).

Interdisciplinarity is not something that comes naturally. Scientific and pedagogical methods must be carefully selected, developed and implemented (Wernli and Ohlmeyer, 2023). Creativity and the knowledge derived from it do not emerge on demand, which affects the success of the approach, but also the overall impression of interdisciplinarity (Hansson, 1999, 341).

As an extension of interdisciplinarity, transdisciplinarity offers holistic schemes that subordinate disciplines and consider the dynamics of whole systems (Klein 1990). Transdisciplinarity is a process in which stakeholders develop and share a common conceptual framework for solving problems or creating products through interaction and information exchange (Stokols et al., 2003). From the beginning, the process includes all relevant professions or scientific disciplines with their specific skills and methods, but also all interested participants from different sectors of society (Toš, 2021, 69). Transdisciplinarity goes one step further than interdisciplinarity and creates a new axiomatics, which is a valuable tool for the theory and practice of already established interdisciplinarities, with the aim of developing a comprehensive synthesis (Turudija, 1982, 34, Lattuca, 2001, 83, Repko, 2008, 15). In other words, transdisciplinarity completely transcends and even ignores the boundaries of academic disciplines in the application of certain theories (Gotal, 2013, 73). It challenges disciplines and seeks new approaches by using materials from existing disciplines and giving them a new purpose (Bernstein, 2015). A broader view of transdisciplinarity suggests that it goes beyond the integration of academic disciplines, so that collaboration and mutual learning between people from practice and society are its salient and necessary components (Scholz and Stauffacher, 2010). Transdisciplinary integration goes beyond academia and addresses issues of societal importance (LERU, 2016). It also involves non-academic stakeholders in the process, such as policy makers, public administrators, and practitioners who may be involved in developing policies or practices related to new areas of research (Razzaq et al, 2013, 155). Digging deeper into the core of the problem leads to more comprehensive, better reasoned, and socially verifiable solutions (Toš, 2021, 69). The incongruent coexistence of
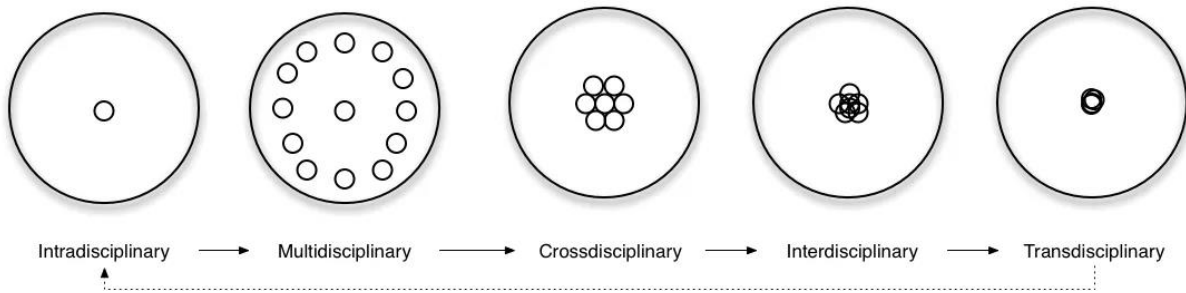
heterogeneous information elements connected by the work of a transdisciplinary interface is likely to promote the emergence of new knowledge (Kerne, 2005). Although theoretically there is a difference between interdisciplinarity and transdisciplinarity, many argue that they are gradations of similar practices (Dykes et al., 2009, Huutoniemi et al., 2010, Griffin et al. 2006, Willson and Pirrie, 2000, Szostak, 2007).

All the mentioned terms refer to teamwork. In addition, some authors consider the terms interdisciplinarity and integration as synonyms for teamwork (Repko, 2007, 2). However, as with the terms themselves, there are gradations and variations depending on the complexity of the contexts and the degree of integration of experts from different disciplines.

Friedman and Friedman (1985) describe a multidisciplinary team as a group of researchers who share resources and research approaches but work independently on a particular part of the problem. Rosenfield takes a similar view (Rosenfield 1992). The goal of a multidisciplinary team is to provide a different perspective on a problem (Dykes et al., 2009, 104). Young suggested that in multidisciplinary teams, different professional groups work to set individual goals and meet to discuss their progress (Young, 1998). Pain also believes that the basis of a multidisciplinary team is that experts from different fields work together on a common topic within the boundaries of their disciplines. However, if they stick to these boundaries, they may reach a point where the project cannot progress. They then need to be brought to the fringes of their disciplines to develop new concepts and ideas and create an entirely new interdisciplinary field (Pain, 2003).

An interdisciplinary team consists of people trained in different disciplines with different concepts, methods, and conditions, united with the common goal of solving a common problem, with constant communication among team participants (OECD, 1972, 25-26). Teams work together, but still on a discipline-specific basis, to solve a common problem (Rosenfield, 1992). Luszki (1958, 11) believes that an interdisciplinary team is necessary because different perceptions need to be integrated or because different observations made by different people on the same object are related. Interdisciplinarity should not be determined by the number of disciplines involved, but by the roles they play and the concepts they use (Luszki, 1958, 10). In interdisciplinary teams, goals are first agreed upon by the team, whose members then coordinate their contributions to the common project plan. (Young, 1998).

Transdisciplinary teams share not only goals but also skills (Young, 1998). In essence, it is an interdisciplinary team whose members have developed enough trust in each other to cross disciplinary boundaries and take a holistic approach (Pain, 2003). Transdisciplinary teams work with a common conceptual framework that brings together discipline-specific theories, concepts, and approaches to solve a common problem (Rosenfield, 1992).

**Picture 1.** Road to transisciplinarity

(from https://welearnwegrow.medium.com/what-is-transdisciplinary-13c16eacf57d)

## 2. EU Practices for the support of interdisciplinarity research

The European Union (EU) has actively promoted interdisciplinary research and the development of interdisciplinary teams in science to address complex challenges, support innovation, and improve the overall research landscape. EU policies and practices in this regard include:

**Table 1.** Different EU policies and practices

| EU policies/initiatives/ programmes | Description of practices |
|---|---|
| *Horizon 2020 and Horizon Europe* | The EU's main research and innovation programmes, such as Horizon 2020 (2014-2020) and its successor, Horizon Europe (2021-2027), explicitly promote interdisciplinary research. They provide funding opportunities for projects that require collaboration between different scientific disciplines to address societal challenges. |
| *European Research Council (ERC)* | provides grants to individual researchers and teams conducting groundbreaking research in a variety of fields. It supports interdisciplinary research and promotes innovative approaches to solving scientific questions |
| *Joint Programming Initiatives (JPIs)* | mechanisms that allow EU member states to coordinate and align their national research programmes. They often focus on interdisciplinary research in areas such as health, climate change, and agriculture, to name a few. |
| *Interdisciplinary research networks* | the EU encourages the creation of interdisciplinary research networks and consortia through its research funding programmes. These networks bring together researchers from different disciplines to work on common goals. |
| *Policy documents* | The EU has published policy documents that emphasize the importance of interdisciplinary research and collaboration. For example, the "Science with and for Society" framework promotes science that responds to societal needs and crosses disciplinary boundaries |
| *Innovation Ecosystems* | The EU supports the development of innovation ecosystems and clusters (e.g. KIC - Knowledge and Innovation Community or European Institute of Innovation and Technology (EIT)) in which researchers, companies, and other stakeholders work together to address complex challenges. These ecosystems often require interdisciplinary collaboration to achieve their goals. |
| *Education and training* | The EU promotes interdisciplinary education and training for researchers. Initiatives such as the Marie Skłodowska-Curie Actions fund fellowships and training programs for researchers, including opportunities for interdisciplinary learning. |
| *Evaluation Criteria* | EU research programmes and funding mechanisms often use evaluation criteria that favour interdisciplinary research projects, recognizing the importance of integrating diverse perspectives and expertise. |
| *Science diplomacy* | The EU engages in science diplomacy that involves international, interdisciplinary collaboration. This can help address global challenges and strengthen relationships with other regions. |
| *Ethical and social dimensions* | Interdisciplinary research often involves ethical and social considerations. The EU encourages the inclusion of these aspects in research projects, especially in areas such as biotechnology and artificial intelligence. |

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While the EU actively promotes interdisciplinary research and collaboration, the successful development of interdisciplinary teams in science also depends on the commitment of Member States, research institutions, and individual researchers to foster a culture of interdisciplinarity, promote collaboration, and share knowledge across disciplines. This approach is critical to addressing complex global challenges and fostering innovation.

The best practices are consistent with the EU's commitment to foster interdisciplinary research and innovation to address pressing global challenges. They emphasize collaboration, knowledge sharing, and responsible research practices across scientific disciplines and contribute to the development of effective interdisciplinary teams in science.

## 3. Why people join teams?

People join groups for many reasons. The most common are interpersonal attraction, personal need for belonging, meaning, or identity, commitment to group goals and activities, and assignment to the group by someone else. Working with others can be satisfying, but it can also be frustrating. As social beings, we look for opportunities to connect with others who share our interests or meet our needs. Groups can help us define, clarify, or understand important issues by discussing them and sharing different perspectives. Groups can also help us develop our leadership skills and deepen our understanding of specific issues. By working with others to clarify issues, we clarify our understanding of a particular topic, strengthen our ability to organize our thoughts, develop our ability to think through problems, and learn to better articulate that thought process to others.

Groups have reasons, purposes, and goals for their existence that draw us to them. These can range from saving the world to changing the grading system or to finding a new way to market a product. The adage "politics makes strange fellows" illustrates that people with very different personalities and backgrounds can have a common goal and therefore often find themselves as members of the same group.

Teams are formal work groups consisting of people who work together to achieve common group goals. Often, they are ongoing groups of individuals who coordinate their activities, even when they are not in constant contact. Special task groups, intact work groups, new work units, or participants from various parts of the organization assigned to achieve a common goal are examples of teams (McShane and Von Glinow, 2000). Teams function as a unit often with little or no supervision, to carry out work-related tasks.

Teams, themselves, rather than a team leader, control the group process. When team members are actively involved, there is a marked increase in understanding, shared vision, collaborative team strategy, and use of the knowledge of the participants. Teams can

effectively improve processes, increase creativity, make higher-quality decisions, improve communication, and respond to global competition (de Janasz, Dowd and Schneider, 2002).

## 3.1. Managing team communication

Managing project communication is a fundamental task for the project manager to lead the project to success. From various studies, successful project managers spend about 75–90% of their time on formal or informal communication. If the flow of information between team members and stakeholders in general is not thought through and managed, the project cannot be considered truly managed. Communication must be planned from the beginning of the project and not left to chance or taken for granted: Who talks to whom, how, and how often - these are questions to which the entire team must provide a clear answer in the early stages. The aspects of communication have a characteristic that adds to their complexity, namely that they must be tailored to the people involved. For this reason, there can be no communication strategy that is always the same and applied to all the projects we manage or to all the projects in our organization, because the stakeholders change with each project, and for this reason the communication strategy must also be able to be adapted.

Compared to a few years ago, today there are also technological aspects to consider: The use of virtual presence systems, video calls, etc. allows multiplying the possibilities of interaction between team members, but also increases the possibilities of interaction and therefore the complexity of management.

One fundamental aspect that everyone agrees on but is often neglected in practice is the need for transparency in communication, because it is one of the fundamental aspects on which trust between team members and stakeholders is based, and a lack of transparency is the aspect that most easily and quickly undermines trust in the project. Whenever possible — and this is much more common than the average person thinks — information should be shared. Another aspect of communication that is often overlooked is the need to ensure that the message reaches its destination, i.e., to set in motion a feedback mechanism between sender and receiver. Part of the communication process involves listening silently to one's counterpart. Often one encounters people who communicate exclusively without making sure that what is said has been received and understood.

The use of multinational project teams is becoming more common in this age of rapid knowledge sharing and globalization (Barkema, Baum and Mannix, 2002). With the increased use of such teams comes a relatively higher risk of miscommunication among members than with traditional work teams, as differences in the national cultures of multinational project team members lead to differences in preferred communication practices and assumptions (Gibson

and Gibbs, 2006; Hogg and Terry, 2000; Hymes, 1974; Kirkman et al., 2013). It is perhaps no surprise that dealing with cultural differences has been identified as the biggest problem in international projects (Turner, 2009). However, do "differences" always pose a challenge to project teams, especially those composed of members with different educational backgrounds?

## 3.2. Dealing with conflicts in teams

Conflict management is a skill that every project manager must cultivate and use frequently during project implementation. Conflict — or disagreement — can occur within the team, between stakeholders, and with customers or suppliers. In any case, if the project manager notices that there is a conflict between some project members and thus a reason for tension, he or she must act immediately to find a solution, because conflicts spread like wildfire and sooner or later become critical for the entire project. Disagreements, on the other hand, are necessary moments in projects because they are the basis for innovation.

When a project manager is called upon to act as a referee in a discussion, he or she must focus on the specific issue at hand and not be influenced by the participants - "don't make it personal!" He or she should try to identify the core problem underlying the disagreement, understand the context in which the problem occurs, and assess the situation from both the rational and emotional perspectives of the participants. In the initial stages, it is advisable to listen to viewpoints, one at a time if necessary, through active listening. Once enough data has been collected, it is necessary to guide the discussion.

In the organizational psychology literature, communication has traditionally been considered a central behavioural process in teams on several levels (Kozlowski and Ilgen, 2006). Specifically, the role of communication in teams is to support other team processes such as cooperation and coordination (Kozlowski and Bell, 2003). In addition, communication supports the general task and teamwork skills required for successful team performance (Morgan, Salas and Glickman, 1993). Thus, individual team members involved in the project tend to communicate information through routine documentation and reports (e.g., monthly progress reports and project status charts). This approach assumes that for the project to be successful, project team members need to know who needs the information, in what form, and where, when, why, and how the information is communicated to stakeholders or key team members (Project Management Institute, 2008).

Hirst and Leon Mann (2004) similarly combine aspects of project management and organizational psychology by developing and testing a model of team communication that includes five factors, some rooted in organizational psychology and others in project

management: (a) leadership role performance — organizational psychology; (b) crossing team boundaries — project management; (c) communication reliability — organizational psychology; (d) team reflexivity — organizational psychology; and (e) task communication — organizational psychology. In this study, communication reliability and task communication were significantly related to project team performance. In addition, communication reliability predicted client evaluation of project performance, while task communication predicted stakeholder evaluation of project performance.

In an interdisciplinary team, effective communication is often a necessary condition for project team success. However, project teams composed of members from diverse backgrounds increase the risk that greater diversity will lead to communication problems that negatively impact performance (Gibson and Gibbs, 2006; Hogg and Terry, 2000; Kirkman et al., 2013). Conversations with colleagues are an opportunity for project team members to learn and share knowledge with each other (Adenfelt and Lagerstroem, 2006; Hymes, 1974). Although conversations can be a valuable medium for sharing information with other team members, communication problems often occur due to disciplinary differences.

One way to examine the challenges faced by project teams that engage in interdisciplinary communication is to use Hofstede's (1980) cultural dimensions as a framework for contextualizing project teams. Hofstede's (1980) model includes four cultural dimensions that impact work-related values: (a) power distance, (b) uncertainty avoidance, (c) individualism/collectivism, and (d) masculinity/femininity. It is particularly important to understand how these dimensions affect project teams because it is especially difficult to reach consensus on standard communication practices in situations where the various dimensions are very different for teams that need to work together (Bantz, 1993). Considering that Hofstede's (1980) cultural dimensions affect team norms, leadership dynamics, roles, and conflict frequency, Bantz (1993) suggests that team members must become accustomed to changing contexts, situations, problems, and the needs of disciplinary diverse teams in order to achieve successful performance outcomes.

Diversity in project teams can have a positive impact on team performance if the conditions are right. Therefore, in the interest of optimal team member composition, some important considerations should be taken into account when forming interdisciplinary project teams and deciding on the range of diversity in each team.

While minimal differences of opinion within a group are likely to be psychologically comforting to team members because they may perceive "each other as "the same" and develop a sense of group cohesion (Elron, 1997), members are also less likely to challenge

assumptions and more likely to develop groupthink (Harrison and Klein, 2007). Group members of such teams may be more satisfied with each other and with the team itself, but this may ultimately lead to poor decision making.

Disagreements and conflicts can negatively impact team performance in many ways, as they can affect collaboration and lead to internal disputes, political actions, or power struggles (Eisenhardt and Bourgeois, 1988). Project managers of teams that are maximally diverse with respect to such an attribute would benefit from interventions to promote collaboration. Increased collaboration can help members create a shared identity for themselves and their role on the project team (Early and Mosakowski, 2000). It is also a useful tactic to avoid the development of "cliques" or "factions" within the main group based on diverse backgrounds (Harrison and Klein, 2007; Gibson and Vermeulen, 2003; Whitener, Brodt, Korsgaard and Werner, 1998).

Project teams go through several phases during their project life cycle, and in each of these phases they may have to deal with conflicts among their team members (e.g., Farh, Lee and Farh, 2010; Jehn and Mannix, 2001). For example, project team members may have different ideas about what features should be added to a product. Similarly, there may be disagreements about who is responsible for not meeting a deadline.

Multidisciplinary teams often involve conflict. Sometimes the conflict is actually a "controversy," i.e., a disagreement over ideas, theories, opinions, attitudes, etc., where the parties seek agreement and share a common overarching goal. However, it is often a "conflict of interest" over scarce (or seemingly scarce) resources where there are seemingly irreconcilable differences. Controversy and conflict of interest are the two most common forms of interpersonal conflict that occur in multidisciplinary teams.

A better understanding of the consequences of intra-group conflict is important because project teams are likely to have a relatively high level of intra-group conflict. For example, a key element of project teams is that they typically consist of team members who differ in knowledge, expertise, and experience. As a result, work-related disagreements often occur because project team members are likely to have different viewpoints on important task- and process-related issues (e.g., Homan, van Knippenberg, van Kleef and De Dreu, 2007; Jehn, Northcraft and Neale, 1999; Pelled, Eisenhardt and Xin, 1999; Van Knippenberg, De Dreu and Homan, 2004). This propensity for intra-group conflict is exacerbated by the fact that project teams must iteratively plan and define the task at hand. As project teams frequently work on new and non-routine tasks, they often need to reevaluate and change their approach. This can lead to conflict, especially when project requirements change frequently (Liu, Chen, Chen

and Sheu, 2011) and when there is a lack of immediate communication among team members (Kankanhalli, Tan and Wei, 2006).

Another problem is that project members may be involved in multiple projects at the same time. This can lead to conflict as some team members find it difficult to meet project deadlines and requirements due to other commitments. Social loafing may also occur, as team members tend to exert less effort when working in a team than when working alone due to their affiliation with multiple teams (Latané, Williams and Harkins, 1979). Because project teams exist for as long as the project or only for the duration of a portion or phase of the project, team members may be relatively indifferent to what other team members think of them. They know that when the project is over, they can go their own way. For some, this means they have little to invest in building good relationships with other team members and therefore have fewer inhibitions about voicing complaints and/or taking out their frustrations on their team members. This is especially true for members of short duration projects and those where members know they will not need to work together again in the near future.

Intra-group conflict is therefore a key element of managing project teams, and it is important to understand when intra-group conflict will hurt or help a project team's performance. For example, teams should be careful that task conflicts do not lead to relationship conflicts, because when things get too personal, people become defensive and stick rigidly to their original positions. When conflicts do arise, teams should manage task and process conflicts in a collaborative manner. In the case of a relationship conflict, it is probably best to ignore the conflict and focus on the task at hand.

To bring together the human resources of geographically dispersed members on a project, electronic communication has increasingly displaced face-to-face interaction in teams, giving rise to computer-mediated communication (CMC) or virtual teams that can span the globe. Distributed CMC radically changes the work environment for these team members and therefore may require different approaches to organization and management to achieve efficiency and effectiveness of outcomes (Hambley, O'Neil and Kline, 2007). A virtual project team (VPT) consists of geographically and/or organizationally dispersed collaborators working toward a common goal using a combination of technologies (Ale Ebrahim, Ahmed and Taha, 2009; Townsend, DeMarie and Hendrickson 1998; Powell, Piccoli and Ives, 2004). Virtual teams carry a higher risk of project failure than teams working together in one location (Cataldo and Nambiar, 2009; Reed and Knight, 2010), and they rely on electronic communication rather than face-to-face meetings, so outcomes may fall short of expectations (e.g., Cummings and

Kiesler, 2007; Lee, Brownstein, Mills and Kohane, 2010). The increasing prevalence of VPTs makes an understanding of the underlying processes essential.

Mediocrity is common due to communication barriers and lack of organizational investment in skill and team building (Majchrzak, Rice, King, Malhotra and Ba, 2000). In addition, virtual teamwork may not be conducive to innovative solutions to complex problems. Hackman (2011, p. 30) wrote that "these … require real-time coordination among different experts to generate an integrated solution." New results require new concepts (Hambley, O'Neil and Kline, 2007). Complex and creative team projects depend on teamwork processes (Crawford and LePine, 2013), which are difficult to develop without extensive personal contacts.

Recent literature on virtual teams has identified team configuration (relative number of members at each site) as a characteristic with potential long-term implications (Cummings 2004). Two characteristics that potentially impact team functioning are membership balance and the number of isolated members, i.e., sites with individuals (O'Leary and Cummings 2007). Balanced membership means that members are approximately evenly distributed among key sites. Virtual team members tend to associate with other members at the same site. Team members in other locations are then considered out-groups (Cramton and Hinds 2005). Balanced membership further exacerbates this in-group/out-group problem. Such local coalitions could in turn lead to misalignment of goals, negative politics, alienation from team identity, and generally poorer team performance (Prasad, DeRosa and Beyerlein 2012). To the extent that balanced membership has a debilitating potential for stalemate, majority influence can seem like a lesser evil. Team configurations in which certain sites have majority membership risk being unrepresentative. However, majority membership often provides security, cohesion, and clarity (Menon and Phillips 2011).

In summary, while virtual project collaboration can present challenges, it is neither a handicap nor an anomaly. In essence, the use of VPTs reflects the times we live in, where entrepreneurship, innovation and talent are trumps.

# 4. Road to interdisciplinarity

## 4.1. Necessity for interdisciplinary team work

Interdisciplinary research team work is a complex process in which different types of researchers work together to share expertise, knowledge, and skills with an overall mutual goal. Despite increasing emphasis on interdisciplinary team work over the past decades, in particular the growth of interdisciplinary education, there is little evidence as to the most effective way of delivering interdisciplinary team work. Most existing research explores the impact of one or a few of these aspects, rather than examining the relationships among several of these components (Nancarrow et al. 2013.).

Despite the increasing focus on interdisciplinary teamwork over the past two decades, there is still no clear synthesis of the "essence" of what makes a good interdisciplinary team and a lack of empirical research to define what such a team might look like. Similarly, there is a lack of data identifying the processes of interdisciplinary teamwork and linking these with outcomes. Studies tend to focus on processes or outcomes, but rarely both; or explore components of what defines an interdisciplinary team, without providing a clear guide on the attributes of good interdisciplinary team practice (Thylefors et al. 2005; Nancarrow et al. 2013.).

The need for interdisciplinary approaches in science and general practice comes out of facts that today's world needs people with innovative and creative solutions and the challenges we face as a society can no longer be solved by traditional, unidimensional ways of reasoning. Today's real-world issues are mostly interdisciplinary, and therefore, require interdisciplinary solutions. Interdisciplinarity draws methods from different disciplines and merges them to produce cognitive advancement that is, examining or solving a theme, problem, issue or experience, with focus on integration, comparing different concepts and insights across subjects to gain new knowledge.

By approaching learning through the study and integration of multiple subjects, we can acquire important life skills such as collaboration, critical analysis and problem-solving, while also being able to apply these abilities to different backgrounds.

## 4.2. How to develop a good interdisciplinary team?

As explained earlier, the term "interdisciplinary team" is not unambiguous, but there is a whole series of interdisciplinary teams that differ in their level of interdisciplinarity, size, functionality, dynamism, efficiency, etc. Therefore, it is not possible to define a single way of developing a good interdisciplinary team. Of course, static and dynamic teams, i.e., those that

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function according to strict procedures, and creative ones cannot possibly be subject to the same principles of successful work and development (Edmondson, 2003). Most often, the theory of team management describes static teams that have clearly defined tasks, and that have a defined stable structure, clear procedures, prescribed communication directions, and defined resources with the goal of achieving a predetermined task. These theories do not sufficiently describe dynamic teams, whose structure is fluid, as well as set goals that are in the sphere of creativity. (Wageman, 2001, West, 2000, Edmondson et al., 2003, Buffinton, 2002, Borkowski and Meese, 2020).

There are a number of characteristics that make a team good. Molyneux (2001) recognizes the personal qualities and commitment of staff, communication within the team, and the possibility of developing creative work methods within the team as prerequisites for its success. As mentioned in the previous section, some of the elements that stand out in research as a prerequisite for a good team are: a clear orientation towards the team's goal, a combination of quality people who have a sufficient level of experience, knowledge, and skills, established quality channels of communication and, ultimately, sufficient resources to achieve the goal. (Mickan and Rodger, 2000, Chen and Lin, 2004, Guimarães et al., 2019, Benishek and Lazzara, 2019) Each of these elements must be of high quality for the team to achieve success. Every good team depends on cooperation and, therefore, in this context, it is necessary to highlight Bronstein's (2003) model of interdisciplinary cooperation, which consists of five fundamental components: interdependence of team members, newly created professional activities, flexibility, collective ownership of goals, and reflection on processes within the team.

## 4.3. How to motivate team members to join the team?

Today, there are conflicting opinions about how good or bad interdisciplinarity is, but there is also an awareness of its necessity in solving complex problems. (Alvargonzález, 2011, Graff, 2016) The problem of insufficient involvement of scientists in interdisciplinary teams has also been recognized. The reasons for not being involved in interdisciplinary teams may lie in institutional or financial obstacles that discourage or inhibit this kind of work, but also in personal fears that an individual faces when leaving the comfort zone of their primary science. (Eisenberg and Pellmar, 2000, MacLeod, 2018)

To solve the first set of obstacles of an institutional and financial nature, it is necessary to work systematically through changing legal frameworks, creating new organizational

structures, encouraging and designing special lines of funding for interdisciplinary projects, etc. (Eisenberg and Pellmar, 2000, Mazzocchi, 2019, Derry and Schunn, 2005).

To address the second set of personal obstacles that an individual must overcome in order to be a quality member of an interdisciplinary team, a number of incentive measures are used. One of the fundamental motivating factors for researchers to join an interdisciplinary team is the absence of limitations that one discipline with its scientific methodology places before them. (Szostak, 2012) This does not mean that interdisciplinarity does not have a methodological framework, but that it expands it by allowing the modification and implementation of methodologies from one science into another, giving scientists the opportunity to create new knowledge. Often scientists' lack of knowledge of other methodological frameworks is a limitation when entering an interdisciplinary team, so it is important to turn this challenge into an advantage of interdisciplinary research from the very beginning. Interdisciplinarity should be presented to the team as a solution that answers questions when their basic science is not sufficient to explain the phenomenon (Klein and Newell, 1997, Collin, 2009).

In higher education institutions, it is important to emphasize the need to create interdisciplinary teams when developing new study programmes, for which it is also shown that interdisciplinary teaching gives students better competencies (Lattuca et al., 2011, Gilbert, 2016). At the same time, working in interdisciplinary teams represents a process of advancement and learning for team members, motivates them to progress, and opens up new knowledge and opportunities for them (Nancarrow et al., 2013).

An extremely important element of creating an interdisciplinary team is the selection of a team leader, whose skills should enable him to observe the broader frame and recognize the possibilities of fitting the specialties of each team member into the achievement of a particular goal, i.e., the realization of a particular project (Edmondson, 2003, Salas et al., 2005). Therefore, for a high-quality and efficient team, it is necessary to work on the continuous training of the leader as one of the fundamental prerequisites for the success of the team. It is up to the team leader to create a comfortable work environment that will allow team members to focus on the task at hand, without wasting their energy on fear of an unstable environment. The team leader is the one who must diagnose the problems that may arise in the interdisciplinary team, offer solutions and devise the most effective ways of implementing them, while improving the team dynamics.

## 4.4. How to choose team members in order to achieve a synergistic effect?

When a team is made up of individuals who have the same educational or work background, it is relatively easy to manage the team and predict the actions and communication of each team member. However, when the team is interdisciplinary and when the education and previous experience of the members are different, problems can arise in the work of the team. Differences in education, communication patterns, status, the language used, and norms of behaviour can lead to misunderstandings and discord in the team. The more diverse the team and the more pronounced inter-/multi-/transdisciplinarity, the greater are the possibilities for problems caused by it. A special problem in this segment is the communication element and the harmonization of professional terminology that will be used by the interdisciplinary team. Members of the interdisciplinary team must, therefore, have exceptional communication skills and must be able to listen and establish connections (Cooley, 1994, Fam et al., 2017). One of the characteristics that a team member of an interdisciplinary team should have is to know how to monitor the actions of other team members, in order to detect errors before they occur or immediately after they occur. (Salas et al., 2005). According to the work of Nicolescu (1999) and Guimarães et al. (2019), inter-/transdisciplinary researchers show openness and tolerance towards ideas that are contrary to their own, accept the unknown, are adaptable and flexible, and are willing to learn from other disciplines. Furthermore, Guimarães et al. (2019) state that such persons must have "(…) the metacognitive skills that enable lifelong learning, including critical thinking, learning on demand, and self-directed learning; the capacity for disciplined self-reflexivity; and finally, the ITDRs' ability to distinguish themselves for having a powerful social conscience and awareness.". A member of an interdisciplinary team who wants to make a full contribution must be able to overcome his feeling of being threatened by the knowledge of another, unrelated scientific discipline and create a need to acquire new knowledge and consider different points of view. They have to feel dissatisfied if they do not see different perspectives of the same problem that is presented to them. (Fam et al., 2017, Guimarães et al., 2019).

Ultimately, all members with their characteristics, skills, and knowledge contribute to the high-quality performance of the team, and their interrelationship leads to a synergistic effect that enhances the team's work and is greater than the sum of all their individual effects. To achieve this, team members must not feel threatened, they must trust other team members, and there must be a certain amount of "chemistry between members" that encourages them to succeed. (Kvarnstrom and Cedersund, 2006, Hollaender et al., 2008, Guimarães et al., 2019, Wall and Shankar, 2008) Wall and Shankar (2008) conclude that interdisciplinary work can be difficult, messy, and painful, but that it can be overcome if the dimensions of readiness

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and relationship building between team members and resources that support their work are successfully integrated into it.

> *All members with their characteristics, skills, and knowledge contribute to the high-quality performance of the team, and their interrelationship leads to a synergistic effect that enhances the team's work and is greater than the sum of all their individual effects.*

The quality of the team depends on the clarity of the set goals. Interdisciplinary research defines, analyses, and addresses a problem by (1) understanding the complexity of the problem, (2) taking into account different perspectives on the problem, (3) linking abstract and case-specific knowledge, and (4) developing common good-oriented descriptive, normative and practical types of knowledge to address the issue. (Guimarães et al., 2019) Already at the first step of defining the problem, an interdisciplinary approach is important, because if the research problem is defined through only one discipline, it will not be challenging enough for an interdisciplinary team to solve. It is the goals that direct the attention, motivation, effort, and persistence of team members (LePine et al., 2008) and maintain cohesion.

Interdisciplinarity is often highlighted as a driver of innovation, and thus the promotion of global competitiveness, national security, and economic development. (Lattuca et al., 2012, Castree et al., 2014, Cvitanović et al., 2020) However, these values are relatively rarely communicated to teams through clear visions and goals that are set before them. A theory (Doran, 1981) that a goal must be SMART (Specific, Measurable, Achievable, Relevant, Time-bound) in order to be successful is well-known. Managerial theory also states that the set goals must be clearly communicated to all those interested in their realization and how they must understand them in order to achieve them in a quality manner. Likewise, well-set goals help those who set them to systematically control their execution. (Drucker, 1976, Weihrich and Koontz, 1998) Problems can arise in interdisciplinary teams precisely when setting and understanding the set goal. Therefore, it is necessary to allocate sufficient time and resources so that the problem is clearly defined and understood by all members of the interdisciplinary team. (Klain, 2014) Setting a common goal/goal is important for establishing a shared vision among interdisciplinary team members because it improves efficiency within the team, increases team commitment to achieving the shared vision, and promotes open communication and cohesion among team members. (Cvitanović et al., 2014)

As with the quality setting of common goals in other teams, in the case of interdisciplinary teams it is possible to recommend methods such as brainstorming, focus groups, or the Delphi method (Eggins et al., 2008), or the team leader can offer the first version

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of the goal that the team members discuss, agreeing on an acceptable and desirable goal for everyone. (Monteiro and Keating, 2009) It is precisely these processes of harmonizing goals that lead to an understanding of the challenges that are set before the interdisciplinary team, and thus to their stronger connection and strengthening of the team and its internal ties. (Eggins et al., 2008)

## 4.5. Setting up the team structure and developing processes for the functioning of the team

Xyrichis and Lowton (2008) recognize team structure and processes as extremely important issues in the quality of teamwork. Within these, they further identify important categories such as team size, team composition, space in which the team operates, organizational support, team meetings, clear goals, and process review. In order for the team to be successful, it is necessary to pay attention to the careful definition of each of the mentioned categories from its very formation. The problem being solved will dictate the composition and size of the team solving it. When determining the size of the team, regardless of the scale of the goal to be achieved, it is necessary to ensure that the team is not too large, because it will not be effective in its work. It is important to point out here that in scientific research, the size of the team is often conditioned by the limitations of the number of authors when publishing the team's findings. (Eisenberg and Pellmar, 2000) The minimum number of people making up a team is two (Salas et al., 2005) It is expected that team members do not change during the achievement of the goal, although this is not stated as a necessary characteristic of a team. (Hirst, 2009) Considering the possibility of member turnover, teams can be divided into closed (in which the membership does not change) and open or fluid (which allow the entry and exit of members). (LePine et al., 2008, Benishek and Lazzara, 2019) The structure of teams can be different, so they can be self-managed or managed. While in managed teams it is quite clear that there is a leader whose task is to coordinate the team, the idea of self-managed teams gives freedom to each team member to contribute to the team and thereby direct it. (Wageman, 2001) Depending on the set goals, the appropriate structure of the team is also selected.

> *„If you are a researcher considering switching fields, first, you must love learning. There will be steep learning curves that might feel daunting, but if you love what you do, you will overcome them eventually. Second, start small. You do not need to switch fields immediately or embark on a second PhD, as I did. You can start with mini-interdisciplinary projects with colleagues and friends before deciding whether this path works for you."*, Patricia Dankers, Eindhoven University of Technology, the Netherlands (Nature, 623, 2023)

Working in an interdisciplinary team presents the individual with the challenge of changing their own routines and adopted mental models, which implies adapting to other team members and, ultimately, developing routines that are acceptable to all members, all with the aim of achieving work efficiency. At the same time, each of the team members brings certain external influences to the team, such as, for example, technological improvements in their expert discipline or changes in the ethical framework that guides them. This does not affect only one member, but all team members who have to adapt to these external influences, which they might not even be aware of within their expert discipline. The process of adapting to new conditions or used technologies can be very sensitive, and some projects can fail precisely because of the lack of adaptation to the newly created conditions. Therefore, as one of the prerequisites for the success of the project, the development of the team in such a way that its members share all new technical and social knowledge from their areas of expertise is imposed. Consideration of such new knowledge by experts of different expertise can ultimately often lead to its improvement. (Edmondson, 2003) At the same time, team members may feel relatively insecure due to such changes, which may result in avoiding expressing doubts or uncertainties and adopting a defensive attitude towards new knowledge. (Bronstein, 2003) In this context, the team leadership must be able to coordinate and communicate well in this complex network of different scientific and non-scientific team members. The team structure must be flexible enough to allow creativity in achieving the goals, but at the same time, a clear role structure must be set in the case when the knowledge of different scientific groups is shared, protected, and preserved. (Nancarrow et al., 2013) Marks et al. (2001:358) state the following: "(…) the term teamwork processes describes interdependent team activities that orchestrate taskwork in employees' pursuit of goals.". Processes within a team represent the ways in which team members use certain resources, such as the skills and knowledge of team members, space, equipment, financial resources, etc., in order to achieve team results. (Benishek and Lazzara, 2019) The processes may be different for each individual team, but also different depending on the type or level of execution of the goal that the team achieves. It is important to note here that within the framework of an interdisciplinary team, the processes must be clearly defined and accepted by all team members in order to avoid disagreements caused by the differences in the basic disciplines of the members. The processes must also include providing feedback to team members about the quality of the performance of a particular action, as well as mutual help or taking over the entire task if it is determined that an individual team member is overloaded at some point. (Mark et al., 2001)

## 4.6. Ensuring resources for the functioning of the team

Team members expect support – emotional, informational, and instrumental (practical). (Wall and Shankar, 2008) For the quality achievements of the set goals, the

interdisciplinary team must be provided with the necessary resources. As stated earlier, one of the fundamental prerequisites for a successful interdisciplinary team is communication. In addition to the need to establish a common vocabulary that everyone can understand, it is also necessary to ensure a quality system for communication, the space in which it takes place, etc. (Nancarrow et al., 2013)

Research shows that physical separation of team members is also one of the obstacles to cooperation. With all modern technology, physical meetings give a special dimension to cooperation in interdisciplinary teams, therefore it is necessary to provide team members with a quality space for joint work that is not too far (up to 3 km) from their usual workplace. (Olson and Olson, 2003, Magadley and Birdi, 2009, Kaygan and Aydınoğlu, 2018) Unfortunately, interdisciplinary teams are often physically dislocated, and in order to ensure optimal working conditions for the team, it is necessary to foresee the provision of space that the team will be able to use for its work. If the distances between the team members are too great due to, for example, staying in different countries/continents, it is imperative to provide excellent information and communications technologies for online collaboration, but also means for their regular physical meetings and a space with conditions for occasional joint work. The effect of a shared workspace on collaboration is manifested through participation, togetherness, and team interaction. (Kaygan and Aydınoğlu, 2018)

People are what makes a team. Sometimes it happens that for various reasons people cannot temporarily or permanently stay in a team or give their best in it, and, therefore, it is necessary to have a quickly available quality replacement. In this context, Benishek and Lazzara (2019) discuss another important characteristic of teams, which is how much they are pseudo and how much they are real teams. Real teams are characterized by the interdependence of their members, agreed goals, systematic reflex or performance review, clear boundaries, high autonomy, and defined roles. On the other hand, pseudo teams are a group of people who call themselves a team and work independently or interdependently to achieve their perceived goal, which is not necessarily accepted by all team members. (West and Lyubovnikova, 2012) It is important to emphasize that this document considers only real teams.
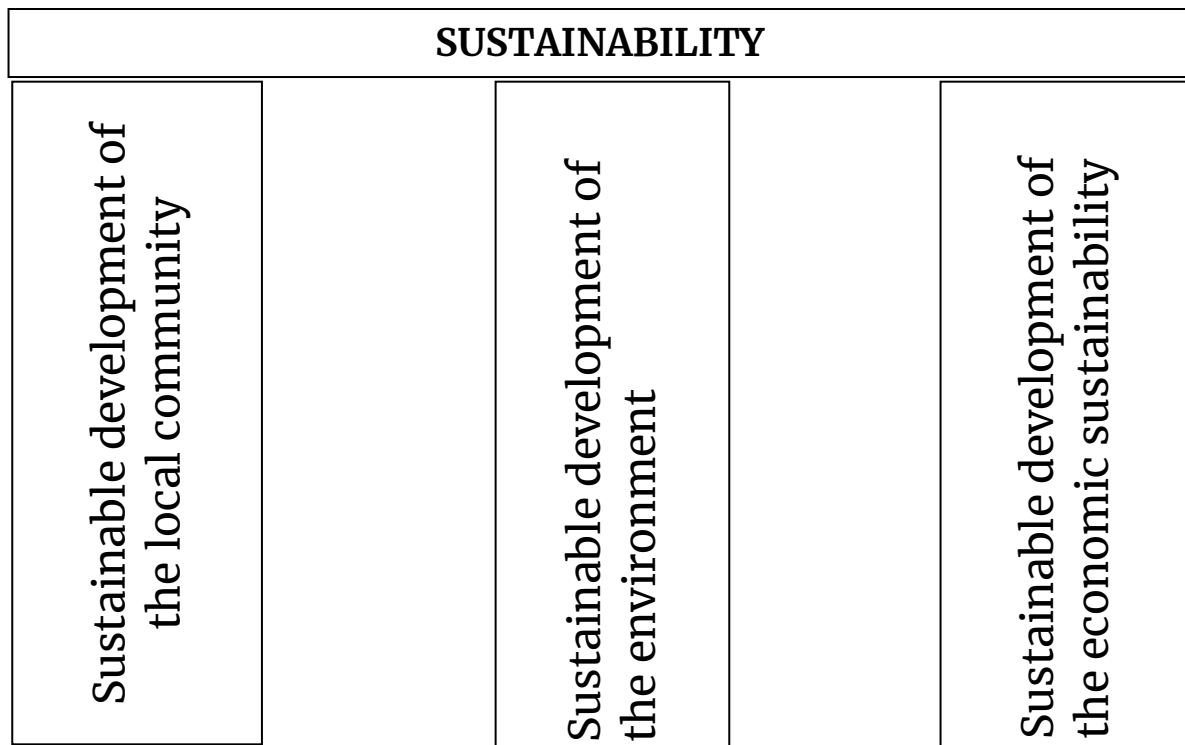
It is interesting that, since the 1990s, above-average funds have been provided for interdisciplinary research in the funding systems, thus strengthening and encouraging such research teams. (Derry and Schunn, 2005) This, in addition to being a significant incentive for the development of interdisciplinary teams, also opens up space for manipulations with the term interdisciplinarity for the purpose of achieving financial benefits, and not necessarily the actual positive effects of the realization of goals through an interdisciplinary approach.

# 5. Example of interdisciplinary cooperation within WP2: Task 2.3. Deployment of a Think-tank on interdisciplinary on SmUCS themes

## 5.1. Organization of scientific conferences and workshops

Within the project activity *2.3. Deployment of a Think-Tank on Interdisciplinarity in SmUCS Themes*, the University of Zadar organized three virtual thematic conferences and three workshops on "Interdisciplinarity in SmUCS research". This action was addressed to all partner institutions and their researchers, with the purpose of joining research capacities on topics of common interest. All three conferences, as well as workshops, were *concerned with the problem of sustainable development of the coastal area*.

| SUSTAINABILITY | | |
| --- | --- | --- |
| Sustainable development of the local community | Sustainable development of the environment | Sustainable development of the economic sustainability |

Picture 2. Three pillars of sustainability

Table 2. Number of different participants of the conferences

| Conference | Sustainable development of maritime tourism | Heritage turns blue: Glocal impacts on coastal cultural heritage | *Blue economy in urban coastal areas* |
|---|---|---|---|
| Number of speakers | 16 | 15 | 13 |
| Number of participants | 64 | 32 | 26 |
| Number of countries | 9 | 8 | 10 |

The first theme "**Sustainable development of maritime tourism"** observed the phenomenon of tourism and its growth from a sociological, economic, and environmental aspect.

Sub-topics of the conference included:

• Blue economy in urban coastal areas

• Adaptation of the blue economy to the climate change

• Environmental challenges in development of blue economy

• The role of sustainable management of aquatic resources underwater heritage

• Marine and maritime heritage within blue economy

• Other topics related to the sustainable development within the blue economy sector

On November 21, the University of Zadar organized the first virtual interdisciplinary conference "Sustainable development of maritime tourism" as part of the RFS project.

The keynote speech was given by Izidora Marković Vukadin, PhD on the topic „Challenges of sustainable tourism management and monitoring sustainability ", after which sessions A and B began. Session A was coordinated by Gabrijela Vidić from the University of Zadar, and the participants/speakers were Edna Hernández González from SEA- EU alliance, Edna Ozuna from the University of Rostock, Sylvain Dejean from La Rochelle University, Pablo Vidal González from the Catholic University of Valencia and Ana Timonina - Mickevičienė from Klaipeda University.

Session B was coordinated by Tomislav Klarin from the University of Zadar and the participants/speakers were Emmanouil Nikolaidis from Frederick University, Maria de Andres

from the SEA-EU alliance, Mariia Iamkovaia from the Agricultural University of Athens, Eduardas Spiriajevas from Klaipeda University, Diana Šaparnienė from Klaipeda University . The sessions were followed by a discussion and conclusions session where the coordinators present the main conclusions from their sessions.

The second virtual interdisciplinary conference "**Heritage turns blue: Glocal impacts on coastal cultural heritage**" within the framework of the EU-CONEXUS Research for Society (RFS) was held on 28th February 2023. Thirtheen speakers presented their recent work related to various impact factors on coastal cultural heritage. 32 attendees listened to the presentations and participated in parallel sessions. Participants included also partners from SEA-EU alliance.

Two keynote speeches opened programme: *Impact of sea level rise on coastal regions - examples from Croatia* by prof. Nina Lončar (Department of Geography University of Zadar) and *A view from the depths: protection and valorization of underwater heritage* by assoc. prof. Irena Radić Rossi (Department of Archaeology University of Zadar). Perfect examples of interdisciplinary research that focus on coastal cultural heritage.  After the opening presentations, parallel sessions focused on the relationship between tourism and cultural heritage and on cultural heritage in different coastal areas. The conference was followed by a workshop coordinated by assoc. prof. Igor Kulenović (University of Zadar) focused on the impact of tourism on the coastal cultural heritage. The ensuing one hour discussion also gave all participants a possibility to present their view on benefits or challenges in integration of interdisciplinarity in their research.

The third conference theme was ***Blue economy in urban coastal areas*** and covered various subjects with an interdisciplinary approach, from sustainable agriculture, fisheries, aquaculture, and seafaring.

It was held on 6th June 11 2023. In total, 13 speakers presented their recent work related to interdisciplinary research related to the blue economy in urban coastal areas. 26 listeners observed the presentations and participated in the conference programme. Beside partners on project event included members of SEA-EU alliance also.

The conference was opened by Vice-Rector Zvjezdan Penezić and moderated by Assoc. prof. Ivan Župan.

Two keynote speeches „*Sustainable aquaculture development and ecosystem services*" were given by Assoc. prof. Tomislav Šarić and "*The role of the Adriatic Sea in rural areas development*" by Assoc. prof. Mladen Rajko.

The conference was followed by a 45 min workshop coordinated by assoc. prof. Ivan Župan (University of Zadar) with major topic focused on the interdisciplinary research related to the development of blue economy in coastal areas. The fruitful discussion also gave all participants a possibility to present their view on benefits or challenges in integration of interdisciplinary in their research. The conference, although in virtual environment, was successful continuation of the two previously held conferences. Conclusions and ideas that were presented will be a great help in deployment of a Think-Tank on Interdisciplinarity for SmUCS. We wish to thank all participants and partners and hope to see you all in future.

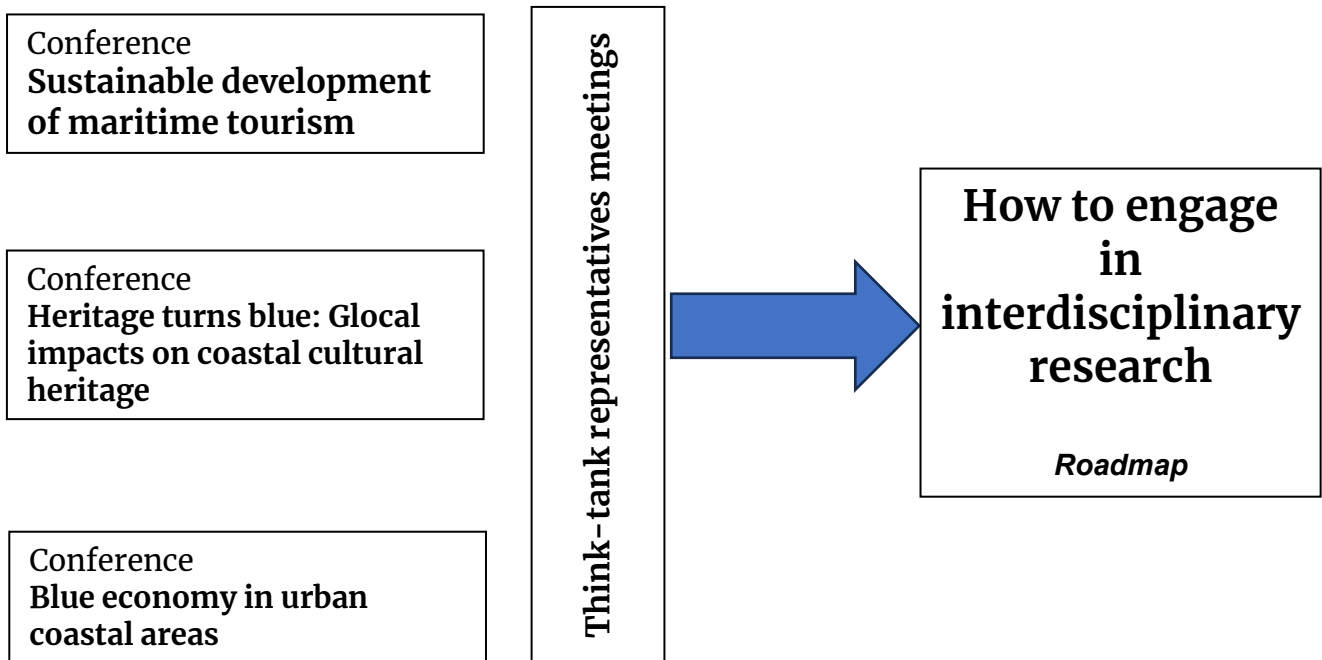## 5.2. Deployment of a Think-tank on interdisciplinary on SmUCS themes

Within the RFS Work Package 2, Task 2.3, one of the major tasks was the deployment of a Think-tank on interdisciplinary research on Smart Urban Coastal Sustainability. After the three above mentioned conferences, the team launched several calls for expressions of interest to researchers from EU-CONEXUS and other institutions to join into a Think-tank. A group of 18 researchers from 8 institutions (within EU-CONEXUS and SEA.EU alliances) was present at the first Think-tank meeting. The aim was to discuss facilitation of interdisciplinary cooperation, especially among STEM (Science, Technology, Engineering, Mathematics) and SSH (Social Sciences and Humanities), develop methodological approaches to succeed interdisciplinary research and encourage interdisciplinary projects within the EU-CONEXUS and SEA-EU alliances. The group had fruitful discussion related to the challenges they face in starting and implementing interdisciplinary research.

Discussions between the Think-tank members raised many new questions, such as:

- *What is the motivation to join interdisciplinary projects?*
- *How can we motivate researchers to join interdisciplinary projects?*
- *Which are the Pros & Cons – Advantages/Pitfalls when forming interdisciplinary teams?*

Based on the outputs of the Think-tank representatives' at 2 meetings, the team from University of Zadar started the work on the **roadmap *"How to engage in interdisciplinary research",*** as a final deliverable of the project, and guideline for the smoother engagement into interdisciplinary work in EU-CONEXUS research activities.

Picture 3. The way to roadmap "How to engage in interdisciplinary research"



| Conference **Sustainable development of maritime tourism** |
| Conference **Heritage turns blue: Glocal impacts on coastal cultural heritage** |
| Conference **Blue economy in urban coastal areas** |

**Think–tank representatives meetings**

→

**How to engage in interdisciplinary research**

*Roadmap*

# 6. Challenges

The popularity of the term has generated various criticisms, with some authors disputing interdisciplinarity and viewing it as epistemologically unfounded. At first glance, it is an attractive but not realistic and useful concept that could serve as a scientific approach (Krishnan, 2009, 6). Matteia Dogan and Robert Pahre believe that it should be completely abandoned (Dogan and Pahre, 1990), and Stanley Fish says that "interdisciplinarity is not only difficult but impossible to achieve" (Fish, 1991, 106). Jack M. Balkin went so far as to attribute interdisciplinarity to the idea of invasion of one discipline over another (Balkin, 1996: 957-958), such that efforts should be made to strengthen a particular discipline and thereby establish boundaries more strongly against other disciplines (Balkin, 1996: 967–970). Although some authors attribute parasitic abilities to interdisciplinarity in the sense that it cannot survive without the existence of the disciplines themselves, which are in turn self-sufficient, this criticism is directed mainly against an "over-enthusiastic and overwhelming" interdisciplinarity pursued at the expense of the disciplines themselves (Hansson, 1999, 340).

Problems with the interdisciplinary approach also arise from the disparity between work that takes a theoretical approach and ones which are reflecting on practical approaches (Villeneuve et al., 2020, 2). The fact is that interdisciplinarity is rarely successfully implemented in practice (Hansson, 1999, 341). Many projects that bear the name "interdisciplinary" reflect the simplified integration of collaborators from different disciplines. In most cases, the approach is multidisciplinary, with individual researchers working independently and producing separate results (Toš, 2021, 67). It is obvious that there are certain difficulties or obstacles that arise from the specific challenges that interdisciplinarity has to face. Most of them can be reduced to a common denominator: knowledge and skills, motivation, and resources.

The first challenge lies in the relationship with traditional disciplines. It is a fact that many disciplines emphasize the authority for the study of certain topics and subjects (Gotal, 2013, 72). This is the result of established division of knowledge and specialization of disciplines, as well as the view that competences can be acquired only within the discipline (Toš, 2021, 69-70). This prevents a part of scientists and experts from becoming familiar with methods of communication with other professions that could be relevant for them in solving problems. Interdisciplinarity requires skills outside one's own field, which need to be constantly improved. It also requires experience, especially in similar collaborations (Hansson, 1999). Because certain disciplines have long developed specific research and work, there is a strong sense of uncertainty when it comes to crossing disciplinary boundaries. It is difficult for

researchers to find a balance between the simplicity of their own discipline and the complexity of integrating ideas from another discipline (Villeneuve et al., 2020, 13). As Rau and Fahy (2013) note, a lack of agreement between researchers from social sciences and natural sciences can be an important barrier to trustworthy and well-integrated sustainability research. One of the examples of methodological problems in interdisciplinary and especially in transdisciplinary collaboration is the problem of contrasting qualitative and quantitative methods and their results (Toš, 2021, 70). Finally, a particular challenge is to identify a problem that requires an interdisciplinary or transdisciplinary approach (Hansson, 1999).

Motivation is increasingly becoming a challenge when participating in interdisciplinary projects. The pressure to achieve excellence within a discipline leaves little room for interdisciplinary work that requires additional training. Especially when the same work is seen as additional work that pushes researchers to the limits of their abilities. Add to this the pressure to publish in leading journals, most of which are focused on one discipline, and the impression is created that participation in interdisciplinary research does more harm than good (Razzaq et al., 2013, 168). In the current framework of scholarly work, interdisciplinary work is simply not sufficiently appreciated. Researchers who aspire to interdisciplinary or transdisciplinary careers often encounter barriers to advancement within their institutions (Wernli and Ohlmeyer, 2023). In addition, promotion only considers the value of one discipline (Chettiparamb, 2007, 37).

Interdisciplinary research centres are often not represented in the organizational mechanisms of universities. Funding is traditionally organized through the disciplines, and reallocation of funds to interdisciplinary programs, centres, or researchers often leads to a reduction in the budgets of the disciplines themselves, which is not welcome (Wernli and Ohlmeyer, 2023). The challenge for the interdisciplinary approach also lies in spatial limitations. The different disciplines are often spatially distant from each other, which reduces the possibility of interaction between researchers (Chettiparamb, 2007, 37).

Finally, one of the biggest challenges, but also a criticism of interdisciplinarity, is that over time it does not become a new discipline with its bureaucratic and administrative apparatus, journals, training, curricula, and career hierarchy (Schwanen, 2018).

# 7. Conclusion and recommendations

In summary, the establishment of a Think-tank dedicated to interdisciplinary research on SmUCS (*Smart Urban Coastal Sustainability*) issues is an important step towards addressing the complex challenges facing urban coastal areas. Through a comprehensive roadmap/guidelines, this initiative aims to foster collaboration between experts from different fields, drive innovation and inform sustainable practices in coastal regions.

The assembled interdisciplinary team, made up of experts from different sciences, can provide valuable insights and solutions to the unique challenges related to sustainability in urban coastal areas. Collaboration with academic institutions, industry partners and government agencies will further enrich the Think-tank's perspectives and enhance the applicability of its findings.

The EU-CONEXUS research agenda, carefully crafted to prioritize SmUCS key themes, will guide the Think-tank in exploring innovative approaches to coastal resilience, environmental protection, and community well-being. Through the organization of workshops and conferences, the task 2.3. aims to facilitate knowledge exchange, promote interdisciplinary understanding and support the development of holistic solutions for smart and sustainable urban development in coastal areas.

Education and training programmes are integral components of the Think-tank's strategy, aimed at equipping current and future generations with the knowledge and skills needed for sustainable coastal development. Through advocacy and collaboration with policy makers, the Think-tank seeks to influence policy to balance urban growth with environmental protection and ensure the long-term resilience of coastal cities.

Continuous evaluation and adaptation are key elements of the Think-tank's approach, which recognizes the dynamic nature of coastal sustainability challenges. By responding to new trends and changing circumstances, the initiative aims to remain at the forefront of creating smart, resilient and environmentally friendly coastal urban areas.

The establishment of this interdisciplinary Think-tank represents a commitment to expanding knowledge, fostering collaboration, and contributing to the development of sustainable solutions for urban coastal areas. By addressing the complex issues of smart urban sustainability in coastal areas, the Think-tank aims to play a central role in shaping a future where coastal cities thrive in harmony with their natural and socio-economic environment and ensure a resilient and vibrant future for generations to come.

The establishment and sustainable structure of the Think tank within the "Research for Society" (RFS) project will not only contribute significantly to the realization of the EU-CONEXUS objectives, but will also bring considerable added value to research cooperation through various aspects:

**Interdisciplinary collaboration**: The Think tank will serve as a hub for interdisciplinary collaboration and promote the convergence of expertise from different fields within the EU-CONEXUS alliance. This collaborative approach is crucial for tackling complex research challenges that require multi-faceted solutions.

**Innovation and creativity**: By bringing together different perspectives, the Think Tank becomes a breeding ground for innovation and creativity. It facilitates the exchange of ideas, methods, and best practices, drives the development of new approaches to research questions and promotes breakthrough results.

**Strategic vision**: The Think tank helps to align research activities with the overall objectives and ensures that the alliance's efforts are directed towards impactful results that contribute to the advancement of knowledge and the well-being of society.

Think tank activities also have added value:
**Efficient use of resources**: The Think tank enables efficient use of resources by avoiding duplication of effort and promoting the sharing of resources among alliance members. This not only optimizes the use of available resources, but also increases the overall productivity of EU-CONEXUS cooperation.

**Improved problem-solving capacity**: Through continuous dialog and brainstorming sessions, the Think Tank improves the Alliance's problem-solving capacity. It provides a platform for researchers to jointly address challenges, share insights and refine methodologies, leading to more robust and comprehensive research results.

**Capacity building**: The Think tank contributes to capacity building of researchers within the alliance by providing opportunities for skills development, knowledge sharing and mentoring. This in turn strengthens the individual and collective capacities of EU-CONEXUS members and promotes long-term sustainability.

In line with the previous recommendations, there are therefore some additional recommendations for the continuation of activities:

**Sustainable impact**: the establishment of the Think tank has already had a positive impact on research cooperation between the EU-CONEXUS research collaboration. Maintaining this structure after the RFS will allow the alliance to build on its successes and continue to make meaningful contributions to the research landscape.

**Long-term collaboration**: Research is an evolving process that often requires ongoing collaboration to address new challenges. The Think tank provides a mechanism for ongoing dialog and collaboration that ensures EU-CONEXUS remains adaptable and responsive to changing research priorities.

**Stakeholder engagement**: The Think tank serves as a valuable interface for collaboration with stakeholders, including policy makers, industry partners and the public. Its continuation will foster strong relationships with external bodies and facilitate the translation of research findings into practice.

In summary, the Think Tank is an indispensable part of the EU-CONEXUS research network. Its objectives are in line with the core objectives of the alliance and its continuation will undoubtedly contribute to the sustainable success and impact of EU-CONEXUS beyond the current "Research for Society" program.

Finally, below you will find the joint conclusions and recommendations for future action:

- **Develop a balanced composition of the team** with the aim of continuing to identify key stakeholders and experts in all disciplines related to SmUCS issues and assemble a diverse team with expertise in the relevant scientific fields.

- **The research and analysis activity** should include a comprehensive literature review to identify current trends, challenges and gaps in SmUCS research, as well as an analysis of existing interdisciplinary projects and collaborations to gather best practices and lessons learned.

- **Identification of priority topics** should include discussions and additional workshops to identify the most important SmUCS topics that require interdisciplinary approaches; prioritization of topics should be based on societal impact, technological advancement, and research gaps.

- **Collaboration and networking** should focus on fostering collaboration with academia, industry and government agencies and organize future interdisciplinary workshops, conferences and seminars to promote knowledge exchange.

- **Project development, public engagement and global collaboration** should aim to facilitate the development of interdisciplinary research projects on selected SmUCS topics. This includes encouraging interdisciplinary teams to work on integrated solutions and developing strategies for public engagement and communication on SmUCS research. This would lead to actively seeking opportunities for international collaboration in SmUCS research and sharing knowledge and resources with global partners to address common challenges.

- Finally, **long-term sustainability** should lead to the development of a sustainable funding model for the think tank to ensure long-term viability and obtain support through government grants and industry partnerships.

These principles formed the basis for the initial meetings that led to the formation of a team to develop proposals for future action. If this roadmap is followed and the joint conclusions and recommendations are implemented, the interdisciplinary Think-tank on SmUCS issues can make an important contribution to advancing research, fostering innovation, and tackling complex challenges in this area. Regular assessments and adjustments will be crucial to remain adaptable and responsive to the evolving landscape of technology and society.

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