Towards a Vision for Team Science at Tilburg University

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1 Introduction

Much of the work conducted at Tilburg University already occurs in a team context. But the term "Team Science" has taken on a new meaning and relevance in the context of Recognition & Rewards. The university has committed to establishing a vision on Team Science in 2023. To meet this mandate, a working group "Team Science" was established within the university-wide program "Use (Y)our Talents" ("Erkennen en Waarderen"). The working group Team Science was asked to write a policy brief to inform a vision on Team Science, paying attention to the following:

1. **Define** team science in the context of Tilburg University (with special attention to the Social Sciences & Humanities, SSH);
2. Explore the scientific **literature** on team science;
3. Develop practical starting points for the **implementation** of team science;
4. Chart national and international **best practices** for team science.

1.1 Team Science and Tilburg University

What does Team Science mean for Tilburg University? To answer this question, we first turn to the University's "Strategy towards 2027", which states that our organization is guided by its four core values of curiosity, caring, connectedness, and courage. These values are intrinsically related to the topic of Team Science.

1.1.1 Curiosity

Curiosity motivates us to ask challenging questions that require more than a single mind to answer. It drives us to seek each other out and learn from each other's perspectives and expertise.

1.1.2 Caring

Caring reflects a respectful and supportive work environment, with attention to diverging perspectives, social safety, and the wellbeing of team members at all career stages. We also care about society at large, and strive to make a positive and ethical impact through our research.

1.1.3 Connectedness

Connectedness is fundamental to team science, which requires strong, collaborative ties among team members from different disciplines across all parts of the organization. It also reflects our relationships to other regional, national, and international stakeholders.

1.1.4 Courage

Courage in team science is about daring to challenge conventional wisdom and take intellectual risks. It involves critically evaluating existing knowledge, being open to novel methodologies, and sometimes going against established views. Teams benefit if members take on complementary roles, and courage empowers members to challenge established views and voice minority opinions, epitomizing the university's commitment to innovation and excellence.

1.2 Defining Team Science

In the academic literature, *Team Science* is defined as a mode of scientific collaboration where research is conducted by more than one individual in an interdependent fashion (Cooke, Hilton, and Council 2015). Most common is collaboration within small *science teams*, typically comprising 2 to 10 individuals, but *large teams* consisting of over 10 individuals also occur. These large teams often encompass multiple smaller science teams and can range vastly in size, sometimes involving hundreds or even thousands of scientists. In large teams, there is typically a differentiated *division of labor* and an integrated *structure* essential for coordinating the efforts of individual science teams. While larger teams afford major impact, smaller teams can drive disruptive innovation (Wu, Wang, and Evans 2019). Therefore, supporting diverse team sizes is crucial for a thriving research ecosystem (Wu, Wang, and Evans 2019). The effectiveness or performance of a team is gauged by its capacity to achieve set goals and objectives, leading not only to improved individual outcomes, such as increased satisfaction, cohesion, and impact - but also contributing to significant team achievements. Team achievements include academic breakthroughs, new methods, and potentially translational applications of the research. Team Science may be characterized by different degrees of *integration* of disciplinary perspectives, ranging from unidisciplinary to multidisciplinary, interdisciplinary, and ultimately transdisciplinary research.

While the academic definition of team science in terms of team size may be objective, it does not convey the core ideals of team science as envisioned by the working group Use (Y)our Talents. In the context of Use (Y)our Talents, this working group defines team science as:

> **Team Science:** collaboration with a larger number of partners than is standard in a particular domain of study, addressing a goal that transcends what could be achieved by a single scholar, with attention to diverse perspectives, and members from multiple branches of the organization (including scientific and support staff), and/or other stakeholders.

1.3 Benefits and Challenges of Team Science

1.3.1 Benefits

[a]

Team science has many advantages, both for individual team members, the organization, and society (Allen & Mehler, 2019). As part of a team, scholars can address larger (societally relevant) challenges than they could individually. In this time of unprecedented social, economic, and ecological crises, this is more urgent than ever before (Cannon 2020). Team science also offers enhanced depth of insight by integrating diverse perspectives - in terms of both interdisciplinarity and intersectionality. Interdisciplinary research teams exhibit increased creativity, productivity, and impact (Cannon 2020; Hinrichs et al. 2017). Still, interdisciplinary team science faces funding challenges due to bias in grant evaluations, favoring narrowly focused proposals (Bromham, Dinnage, and Hua 2016). Science teams can comprise academic and support staff, enabling specialization and a more efficient division of labor. Science teams can also incorporate societal stakeholders or corporate partners, amplifying impact and potential valorization, respectively. Team science benefits individual researchers because resulting publications have a citation advantage (Wuchty, Jones, and Uzzi 2007); an advantage that may be particularly attractive to early career scholars. It also benefits early career scholars by creating opportunities for mentoring by more experienced staff (DeHart 2017). Collaboration in science also significantly benefits employee well-being and empowerment, while addressing issues like workplace isolation and underperformance (Mydin, Radin A. Rahman, and Wan Mohammad 2021). Team science benefits the work culture by cultivating a sense of community. It can also increase the sense of social control and accountability, benefiting the reproducibility and trustworthiness of results. Teams offer networking opportunities and foster peer-to-peer skills transfer, as members are exposed to various methodologies and perspectives. A diverse, collaborative environment is not just a catalyst for innovative research but also a bedrock for cultivating well-rounded scientists equipped for the multidimensional challenges of contemporary research.

Summary: Team science allows scholars to provide complex solutions to large-scale public challenges. It promotes collaboration, cohesion, and knowledge exchange within organizations, increases impact, and may benefit research quality.

1.3.2 Challenges

Team Science, while beneficial for advancing research, presents several challenges that can impact its effectiveness. It incurs costs in building relationships and aligning perspectives, and the *average* quality of team work may be lower, compared to the average quality of highly specialized research (Bromham, Dinnage, and Hua 2016). Also, cooperative science centers face ongoing challenges in measuring and comparing team science performance (Gibson, Daim, and Dabic 2019). In the literature, seven specific challenges of team science have been identified (Cooke, Hilton, and Council 2015). Firstly, the high *diversity* of membership in terms of disciplines, cultures, and backgrounds, while enriching and promoting innovation and creativity for impactful discoveries Nielsen et al. (2017)], can also lead to communication barriers and differences in methodologies or perspectives, which can negatively impact the research process and result quality (Kosmützky 2018; Wallerstein et al. 2019). Teams should be sufficiently diverse to ensure different perspectives are represented, engage in reflexivity - considering how the researchers' perspectives influences the research, and considering whether relevant perspectives are represented - and strive for successful communication and mutual understanding. Secondly, deep *knowledge integration* across various fields requires overcoming intellectual silos, demanding a synthesis of diverse theories, tools, and data (Conn et al. 2019). "speakacclimatizeTeams should actively synthesize contributions from different members. Thirdly, managing *large teams* poses logistical challenges in coordination, communication, and maintaining a unified vision (Conn et al. 2019; Campbell-Voytal et al. 2015). The paradox of team size is that smaller teams are typically better coordinated, while larger teams nonetheless outperform in publications, patents and citations (Cummings 2018).[b] Psychological safety, a.o. a sense of confidence that you will not be rejected for speaking out, is crucial for trust, cohesiveness, and achieving scientific goals (Patel et al. 2021). Furthermore, *goals* can often become misaligned with other teams, leading to conflicts in priorities and directions. To overcome this challenge, participatory goal setting is advised (Campbell-Voytal et al. 2015; Patel et al. 2021). Particularly in light of the precariousness of (early-career) academics, teams can have *permeable boundaries*, with members transitioning in and out of teams, requiring the rest of the team to adapt and realign. *Geographic dispersion* of team members across different time zones and locations requires the use of digital tools, hybrid work, and asynchronous collaboration - and can impede team cohesion. Lastly, high *task interdependence* means that the success of the entire project depends on each member's contributions, amplifying the effects of any discordance or inefficiency within the team. Overcoming these challenges requires institutional support, strategic management, and effective communication (Conn et al. 2019; Surratt et al. 2023; Read et al. 2016; Jeong and Choi 2015; Forscher et al. 2023; Campbell-Voytal et al. 2015; O'Rourke et al. 2023; Ghamgosar, Nemati-Anaraki, and Panahi 2023).

Summary: Any science team should be aware of, and reflect on how they relate to, the seven challenges of team science: diversity, knowledge integration, team size, goals, permeable boundaries, geographic dispersion, and task interdependence.

2 Good Practices

To observe good examples of team science projects, we can take a local, national, and global perspective. Within our own university, there are many great examples of team science in different forms.

2.1 Local Perspective

Team science already comprises a substantial part of research conducted at Tilburg University. When analyzing publication records of our staff of the past five years, we observe that the majority of publications has two or more authors; the proportion of single-authored publications is decreasing steadily, and the proportion of publications with more than 10 authors is increasing steadily, see Figure Figure 1.

Team science is thus quite common at TiU, but analysis of author affiliations provides a more nuanced picture. Specifically, only 3% of publications between 2019-2023 included authors from more than one school. By comparison, 66% of publications in the same timeframe included authors from outside TiU. In terms of societal stakeholders, 18% of pubilcations in this timeframe included authors not affiliated with any university (government employees,

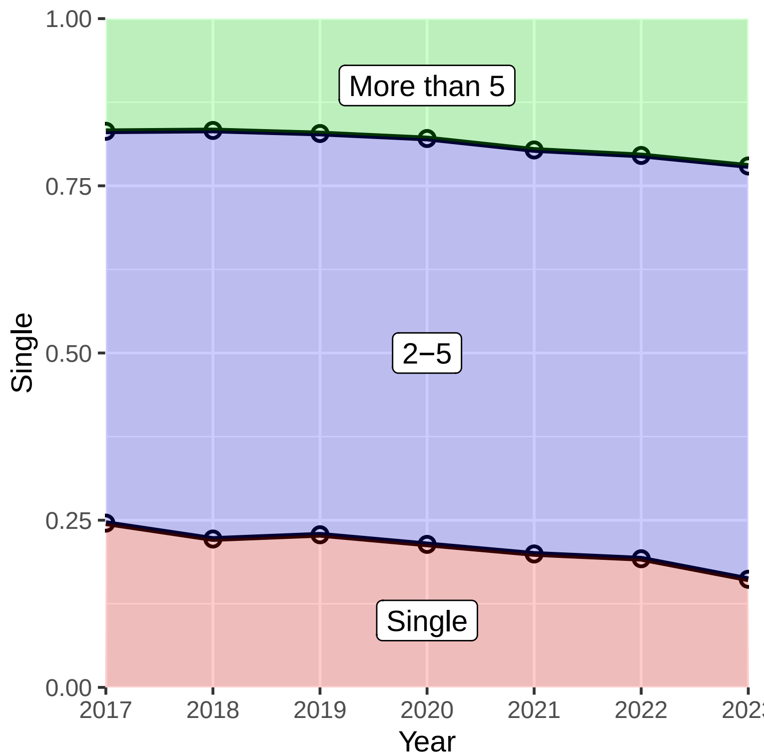

Figure 1: Proportion of team science publications at TiU

those at independent research institutes, corporate stakeholders, medical professionals, those working in media, and at private non-profits).

These statistics strongly suggest that interdisciplinarity and connecting the schools is low-hanging fruit; much can be gained by promoting team science that involves colleagues from different schools. Especially considering that TiU is a relatively focused institute - all schools fall within scope of the social sciences and humanities - this should be highly feasible. Considering TiU's embedding within the province, stimulation of collaboration with private stakeholders may also be beneficial. Collaboration with external scholars already abounds, and may thus be less of a priority. (Ear-M: Output Assessment and Motivating Input Changes (O))

Recommendation: At present, only 3% of academic output involves authors from multiple Schools. Promoting team science that connects the schools is low-hanging fruit, and should be a priority.

Of course, statistics are only part of the story, so we also consider some examples of notable team science efforts at our university (see vignettes in Table (**tab-tablocal?**)).

Table 1: Vignettes of local team science examples

Project	Goals	Team.Composition	Successes	Challenges
Digitalization of Health and Well-being (a) [anonymous team members]	Establishment an interdisciplinary research program/group about digitalization of health and wellbeing.	Six assistant-professors from various schools of the university + the dean of TSHD.	The team has built relationships, secured internal ICON funding, and made progress in defining practically achievable goals.	Establishing the team was complicated by lack of clarity about membership and functioning when members signed their contracts. The project's goals have been unclear, and attempts to clarify them are sometimes hindered. There is tension due to the hierarchical structure. This leads to an information asymmetry between leadership and members. Some members would prefer a more egalitarian peer-to-peer network. Some noted conflicts due to misalignment between team members' individual interests and the project's scope, feeling as though the group was formed more for administrative reasons than in pursuit of a shared research goal. A grant application that many team members had contributed to was shelved because the core team received ICON funding, leaving other contributors to feel passed over after investing effort.

Project	Goals	Team.Composition	Successes	Challenges
Digitalization of Health and Well-being (b) [vision manager]	Establishing an interdisciplinary research group to collaborate with partners, exchange knowledge, create academic and social impacts, and work towards long-term improvements in mental health.	The research team is in progress, aiming to unite all five schools at Tilburg University. Currently, TSHD, TSB, and TLS are actively engaged, while TiSEM and TST are less involved. The goal is to also eventually involve all relevant external parties, but some contracts are still being finalized.	Many want to join this open project without strict criteria, fostering interdisciplinary exchange. Partners are equal, though the core team holds more control and tasks are divided by the core team but with team member's consent.	Participating in the research team alongside existing work is challenging due to budget constraints. Aligning goals with partners can be a challenge, but joint goal-setting based on overlapping challenges and missions seem to be successful. Age diversity exists among team members, but there's limited cultural diversity.

These vignettes indicate major advances have been made in terms of team science efforts in recent years. Important lessons have been learned in terms of rigid hierarchy (see Section 4 and Section 3.3), shared goals and representations (see Section 3.1) and transparency and fairness (see Section 3.2). Future team science efforts at TiU should build upon these lessons learned, and build in a flexible hierarchy, transparency and procedural fairness from the start, and engage in shared activities and/or trainings to establish shared goals and representations.

2.2 National Perspective

For national examples of Team Science, see Table (**tab-tabnational?**). Note that four schools of TiU are members of ODISSEI (TLS, TiSEM, TSH, and TSB), and TiU staff are also part of the second team science initiative mentioned.

Table 2: Vignettes of national team science examples

	Project	Goals	Team.Composition	Successes	Challenges
3	Voting advice applications (EU funded project)	Understanding the effect of voting advice applications on the population, and society at large.	Three universities in three different countries (NL, UK, TU). A core consortium convened a larger research team and partners.	The project was successful: training three PhD students, collecting substantial data, and publishing papers. It had social impact through conference participation and non-academic output. The initial goal was further concretized over time. Interdisciplinary communication challenges were overcome, providing learning opportunities. The team's disciplinary and demographic diversity did not hinder collaboration.	Communication challenges arose due to team members being geographically dispersed. Phone and internet communication were perceived as less effective than in-person interaction. Scheduling conflicts and varied commitments across countries complicated collaboration. Involving companies added complexity, as their goals (business results) differed from the academic focus on publications. While there was no goal misalignment, strategies to pursue those goals differed. Task interdependence occasionally caused delays, but wasn't a major issue.

	Project	Goals	Team.Composition	Successes	Challenges
4	ODISSEI	This national research infrastructure supports ~300 interdisciplinary projects annually. It facilitates collaboration among social science and economic faculties in the Netherlands, removing barriers for researchers, such as connecting them with interdisciplinary expertise and data.	Every social science faculty and some economic faculties in NL, and ~80 team members working at ODISSEI. The 300 annual projects each have teams with about 1-4 team members.	The successes lie in its efficient online communication which promotes flexibility, a simplified and (disciplinary and demographically) diverse team, and a horizontal, federated structure that empowers individual researchers, fostering bottom-up innovation. The project has successfully united an interdisciplinary diverse group, enabling groundbreaking research through collaborative expertise.	Managing the complexity of diverse disciplines with distinct languages and taboos remains a challenge. Task-interdependence requires effective communication, with regular interventions to keep team members informed and engaged. The project tries to emphasize the effort needed to avoid assumptions and maintain collaboration, as it's easy to overlook progress and responsibilities within a complex team-environment.

2.3 International Perspective

Team science that spans country borders is relatively rare, with approximately 90% of papers published by authors from a single country (Akbaritabar & Barbato, 2021). Many of the most notable international team science examples hail from the "hard" sciences. But still - there are inspiring examples of global team science initiatives in the SSH domain. One of the most well-known examples is the "Many Labs" project, established by former TiU-employee Richard A. Klein. Motivated by the so-called "replication crisis" (Open Science Collaboration 2015), this crowdsourced initiative recruited several hundred social science departments around the world (R. A. Klein et al. 2014). The consortium set out to replicate published psychological effects and assess variation in replication results across samples and settings. Similar "Many Labs" projects have been established in developmental science (ManyBabies, Byers-Heinlein et al. 2020) and neuroscience (EEGManyLabs, Pavlov et al. 2021). A more general consortium has been established to empower future many labs studies: the Psychological Science Accelerator (PSA) is a globally distributed network of researchers (2468 researchers from 73 countries) that pool their resources to replicate submitted studies.

Another example of SSH team science is the PsyCorona consortium, an ad-hoc collaboration with over 130 scholars from 70 different countries, established within the first week of the COVID-19 pandemic (Leander et al. 2020). Before vaccines were developed, behavioral measures were the only countermeasure to slow the spread of the virus, and this consortium set out to collect social scientific data to advise policy for effective behavioral interventions. PsyCorona was founded at Groningen University by Pontus Leander, and its data science team was headed by TiU-employee Caspar van Lissa. Jointly, the PsyCorona consortium published several dozen papers. These examples highlight the enormous potential of large-scale consortia in the social sciences. When researchers band together, their impact is amplified.

3 What the Science of Team Science Says

3.1 Team Effectiveness

(Ear-M: Changes to Drive Collaborative Initiatives:) (Ear-M: Enhancements in External Inputs, Training, and Team Building (P)) Team effectiveness, or team performance, is defined as the team's ability to achieve its goals and objectives. This concept has been extensively explored in the literature, with substantial influence from the input-process-output (IPO) model (McGrath 1964). The input-process-output (IPO) provides a way to understand how teams perform, and how to maximize their performance . Team effectiveness hinges on inputs such as the team composition and the nature of the problem at hand. The processes, involving the team members' cognition, motivation, affect, and behavior, are crucial in enabling the team to meet task demands effectively. When the output resulting from these processes aligns with the task demands, a team is considered effective.

Let's consider some of the processes that facilitate team effectiveness. Central to effective teamwork are processes like *team mental models* and *transactive memory*, which entail shared understanding of task requirements, procedures, role responsibilities, and an awareness of each member's knowledge and expertise (Patel et al. 2021; Ghamgosar, Nemati-Anaraki, and Panahi 2023; Mehta and Mehta 2018).
Formulating explicit goals, adaptive problem formulation, and participatory processes help build mutual understanding among team members (Vogel et al. 2014; Pennington 2016). At the team level, team climate also plays a pivotal role, and is shaped by organizational strategies, team leaders' communications, and the interactions and shared understandings among team members. Team spirit benefits from a healthy balance between individual and collective needs and expectations (Getha-Taylor, Silvia, and Simmerman 2014).
At the institutional level, well-structured support for team science and an innovation-friendly academic culture benefit optimal transdisciplinary collaboration (Michael M. Crow and Dabars 2019). There is an association between interpersonal relationships and scientific productivity on a scientific team (DeHart 2017; Love et al. 2023). Psychological safety fosters a climate supportive of risk-taking, learning and daring to speak out, which is crucial for effective error management and innovation (Edmondson 1999; Patel et al. 2021). Moreover, motivational

and affective processes within a team, such as a sense of team efficacy, are essential. Leaders can foster individual self-efficacy by empowering team members to have *mastery experiences*, and then shift the focus towards the joint efficacy of the team. Leadership efforts also ought to address team members' alignment with team goals, and providing socio-emotional support (Steve W. J. Kozlowski and Ilgen 2006).

Recommendation: Team effectiveness is best enhanced by thoughtful team composition, team professional development (including actively working towards shared understanding of goals, task requirements, and team member competencies), and inspiring team leadership.

3.2 Communication and Team Success

(Ear-M: Changes that Enable Individuals to Lower Barriers to Interaction and Teamwork (I)) Transparent communication is integral to team success, particularly in scientific and academic settings (Forscher et al. 2023; Conn et al. 2019; Patel et al. 2021); effective communication can facilitate interpersonal trust, increase productivity, and spark innovation. Communication training is crucial for cultivating vital team science skills such as trust-building, exchanging worldviews, and conflict management (Read et al., 2016). In team science, intellectual conflicts are not only inevitable but also essential for advancing knowledge (Collins 1998). Successful science teams promote intellectual disagreement and discussion (L. Michelle Bennett and Gadlin 2012). Such an environment encourages ongoing dialogue, working through issues, and prevents the accumulation of unresolved problems, simultaneously fostering the development of trust (Brody et al. 2019).

Effective conflict resolution is also important (Read et al. 2016). There are two primary conflict management strategies: reactive and preemptive (Marks, Mathieu, and Zaccaro 2001). Reactive conflict management involves resolving disagreements through problem-solving, compromise, and flexibility, while preemptive strategies anticipate potential conflicts, guiding them in advance through cooperative norms, charters, or other structures. S. W. J. Kozlowski and Bell (2013) further emphasize the importance of these approaches in shaping conflict processes constructively. In essence, the efficacy of team communication, particularly in handling intellectual disagreements, is a significant determinant of a team's success in the scientific field.

Recommendation: Team members should be able to disagree constructively in a safe, supportive context. When possible, preemptive conflict management strategies should be used; anticipating disagreements and establishing terms for their constructive resolution. When conflict does occur, reactive conflict management should focus on empathy, problem-solving, and compromise.

3.3 The Role of Trust

Effective interdisciplinary collaboration and team science hinges on the establishment of trust between all parties involved (L. Michelle Bennett and Gadlin 2014; Read et al. 2016; Zajac et al.

2021). Increased engagement between scientists and stakeholders leads to more mutual trust as well (Meadow et al. 2015). Trust is not just about believing in each other's competence, but also involves perceptions of fairness and transparency in the organization, which is crucial for nurturing a collaborative environment. Transparent communication, decision-making, and enforcement builds mutual trust; for example, by drafting formal collaboration agreements before teamwork begins (Forscher et al. 2023). Building through joint identification of objectives, co-developed guiding principles and ongoing team reflexivity throughout the evaluation strengthens trust between project members and evaluators (Roelofs et al. 2019). Team trust facilitates coordination and cooperation, thereby enhancing team effectiveness (Breuer, Hüffmeier, and Hertel 2016). Team challenges, like rigid hierarchy and diverse professional backgrounds, can erode trust, particularly in dynamic teams with changing memberships (Zajac et al. 2021). Trust is especially important in virtual teams relative to face-to-face teams, which could be attributed to the unique challenges of remote collaboration, where trust compensates for the lack of physical presence and direct oversight. Interestingly, the importance of trust diminishes in environments where team interactions are thoroughly documented (DeHart 2017), suggesting that transparency can partially replace the need for trust (Breuer, Hüffmeier, and Hertel 2016). This insight provides some justification for the effectiveness of the open science movement in promoting team science. (Ear-M: Enhancements for a Collaborative Team Environment (I)) **Recommendation**: Ensure trust within team contexts to facilitate effective collaboration, for example, through procedural fairness and transparency within science teams and the broader organization, and through physical contact between team members.

3.4 Team Composition[c]

Research on team composition and team effectiveness has yielded conflicting results, highlighting the complexity of this relationship. The importance of team composition is likely related to the complexity of the task at hand, the degree of interdependence among team members, and the duration of the project (Carter et al. 2019). Research in non-science contexts has underscored the importance of *task-relevant diversity*, which positively impacts team effectiveness, fosters innovation and creativity, and increases impact (Cooke, Hilton, and Council 2015; Nielsen et al. 2017). At the same time, the benefits of having larger and more diverse groups may diminish when there is increased heterogeneity in disciplines and institutions of team members. Introducing new members who are not prior acquaintances can enhance the effectiveness of science teams, suggesting a benefit of fresh perspectives and expertise. At the same time, when teams consist of (geographic) subgroups, this can increase conflict and distrust (Polzer et al. 2006; Bromham, Dinnage, and Hua 2016). Top-down requirements on team composition imposed by science leaders or funding agencies, such as mandating the inclusion of certain individuals, disciplines, or institutions, can backfire, creating internal goal conflict. This highlights the delicate balance required in team composition to optimize effectiveness, considering both the diversity of skills and perspectives and the potential for conflict and misalignment of goals.

Recommendation: When composing a team, it is crucial to weigh the benefits of *task relevant diversity* against the downsides of overcoming disciplinary, institutional, or demographic differences.

Recommendation: Starting at the undergraduate level, train young academics in interdisciplinarity and collaborative skills. (Hall, 2020)

3.5 Permeable Team Boundaries

Teams can be independent entities with permeable boundaries, not intrinsically connected to any one member (O'Rourke et al. 2023). Permeable boundaries allow teams to reconfigure in response to evolving task demands (Mathieu et al. 2014). This fluidity brings both challenges and opportunities (Tannenbaum et al. 2012; Zajac et al. 2021). On the positive side, membership fluidity can facilitate the transfer of knowledge across teams and organizational units, introducing fresh perspectives and ideas. It benefits team flexibility and adaptability (Gorman and Cooke 2011), and contributes to a richer pool of unique ideas (Gruenfeld, Martorana, and Fan 2000). On the downside, however, such fluidity can potentially weaken team cohesion and stability. It should also be viewed in the light of precarity among early career researchers: If young scholars move in and out of teams, contributing knowledge and effort without retaining ownership, the burden of team membership might outweigh its rewards for them. Thus, care should be taken that young scholars are sufficiently recognized and rewarded for team contributions.

(Ear-M: Changes that Enable Individuals to Lower Barriers to Interaction and Teamwork (I))

Recommendation 1: There should be a balanced approach to permeable team boundaries, leveraging the benefits of diverse and adaptable membership while maintaining a core of stability and security to foster team cohesion and sustained performance.

Recommendation 2: For all temporary team members, in particular ECR and those on temporary contracts, the balance between investments (in terms of time and effort) and rewards should be explicit and fair.

3.6 Support staff

Support staff can bring specific professional expertise, skills, and perspectives to bear on team science projects, enhancing the quality of work and enabling more efficient division and delegation of tasks [Bosch, 2023]. At present, however, support staff are not always fully integrated and recognized within the academic ecosystem (Bosch et al. 2023). To promote integration of support staff, Bennett and colleagues (2023) propose several changes: Firstly, to reconsider recognition and rewards from the perspective of support staff as well; valuing their contributions to team science, irrespective of the outcomes. Secondly, to take a more modular approach to research, where "intermediate output" can also be recognized and rewarded. For example, support staff may be involved in the curation of a database, which could then be made FAIRly available, allowing support staff to be recognized for the creation of this resource. Thirdly, there should be an ongoing discussion about recognizing support staff contributions to academic publications. Support staff may often be eligible for coauthorship according to discipline-specific criteria. For example, if support staff perform tasks that fall within the CRediT authorship taxonomy (see Section 6.3). If support staff are not eligible as coauthors, or do not want to take on the responsibilities of coauthorship, then it is crucial that their contributions be otherwise acknowledged, recognized, and rewarded. Lastly, it is important to standardize and professionalize support staff career paths and function descriptions in a way that is distinct from the traditional "researcher" versus "non-researcher" dichotomy. This would allow for greater involvement in team science, and concomittant recognition and reward of support staff.

Recommendation: Recognition and rewards should affect support staff as well, ensuring that support staff are incentivized to contribute to team science.

Building relationships between academic- and support staff is also important, if the goal is to involve support staff more in team science. One way to do so is to include support staff alongside academic staff in team science-related training activities [Hall, 2008]. In a broader sense, ensuring that all staff feel welcome and included in TiU social events can help increase integration. Some universities have altogether abolished the distinction between scientific and support staff, clearly signaling a vision for further integration of these roles (Agterberg 2023).

Recommendation: Increase social and professional ties between all university staff (scientific and support) by welcoming all staff at the same training- and social events.

4 Institutional Policies and Support

According to research, organizations can create a climate conducive to team science by providing incentives for collaboration, flexible hierarchies, a high degree of autonomy, a culture of transparency (open science), recognize and reward contributions to team science, and provide inspiring team-oriented leadership (Stokols et al. 2008). These principles should be guiding when designing policy to promote the broader uptake of team science at TiU as well. Historically, academic policy in the Netherlands at various levels has focused primarily on "excellent individuals". If our University's goals shift towards a greater emphasis on larger societal challenges that can only be resolved through team science, then exiting policies and support structures should be re-examined with those goals in mind.

Recommendation: Create a climate conducive to team science by incentivizing collaboration, making hierarchies flexible, supporting autonomy, embracing open science, recognizing and rewarding team science, and providing inspiring team-oriented leadership.

Recommendation: "Excellence" does not exclusively refer to individual performance, but also applies to team efforts.

4.1 Flexible Hierarchies

Universities tend to be relatively hierarchical organizations, with clearly defined roles at each level, and a high level of differentiation into functional departments (e.g., the schools, library, etc). Such hierarchical organization can be at odds with universities' core business, as more flexible structures and integration across hierarchical levels and departments are best suited to research-intensive fields, like academia (Burns and Stalker 1994). In order for team science efforts to flourish, universities will need to strike a balance between hierarchy and specialization on the one hand, and collaboration and integration on the other (Lawrence and Lorsch 1967).

Recommendation: In order for team science to flourish, TiU must balance hierarchy and specialization on the one hand with collaboration and integration on the other. Hierarchy must be flexible: it must be possible to check, question, and even challenge authority.

4.2 Top down and Bottom Up

Ensuring a successful shift of the corporate culture towards greater team science requires both top-down and bottom-up initiatives (Duhigg 2014). Top-down approaches might involve policy changes or even reorganization. For example, consider Arizona State University (ASU), a pacesetter of team science in the United States. ASU restructured their organization, creating new interdisciplinary schools and research centers (Michael M. Crow and Dabars 2014). For an example of bottom-up change, consider the University of Southern California (USC). At USC, a seed fund was established to fund interdisciplinary team science, and promotion and tenure policies were revised to acknowledge team science (Cooke, Hilton, and Council 2015). These efforts empowered individual faculty members and teams, giving them the resources and recognition necessary to pursue collaborative, interdisciplinary work. Combining top-down and bottom-up approaches is critical to ensure effective change of the organizational culture. Top-down strategies ensure institutional support and alignment with the institute's strategic goals, while bottom-up initiatives ensure buy-in from staff.

Recommendation: To enact a desired culture change towards more team science, a combination of a top-down (through policy, funding opportunities, and recognition and rewards) and bottom-up (through informal networks like the Open Science Community, and social, academic, and networking events) approaches is necessary.

4.3 Funding Team Science

(Ear-M: Enhancements in External Inputs, Training, and Team Building (P))(Ear-M: Changes to Drive Collaborative Initiatives:)

Financial support plays a crucial role in nurturing and sustaining team science. Via the allocation of public funds ("eerste geldstroom"), TiU can promote team science internally. There are good arguments in favor of using public funds to promote team science: The same amount of money can affect more people's careers in a more impactful way (because larger projects can be addressed), all the while promoting cohesion within the organization. In order to do so effectively, however, a comprehensive and forward-thinking approach is required. The university should work with its research- and support communities to foster the development of innovative collaborative models like research networks and consortia. The needs of these networks and consortia can help shape new funding instruments and incentives. If funds are made available via calls for proposals, TiU should mandate that team-based research submissions include detailed collaboration plans. This ensures that researchers are not only focused on the scientific and technical merits of their proposals but also on the feasibility of effective collaboration. Providing guidance on crafting these plans and setting criteria for their evaluation can enhance the quality and success rate of interdisciplinary or transdisciplinary research projects.

Recommendation: Using public funds (eerste geldstroom) to fund team science initiatives can affect more colleagues' careers in a more impactful way, while promoting cohesion within the organization. To do this fairly and transparently, the target audience should be included in the development of funding calls.

Recommendation: Applications for team science funding instruments should include a collaboration plan as part of the evaluation criteria.

One effective approach to fostering innovative team science is through incubator grants. Such grants are designed to support the developmental phases of team science, providing crucial "incubator space" for the generation and advancement of new cross-disciplinary ideas Council (2007). Additionally, project development or pilot funds offer flexible financing for just-in-time innovations or integrative ideas that emerge during larger collaborative projects Vogel et al. (2014). Flexibile funding (smaller sums that can be applied for without too much administrative overhead) is key to accommodating the dynamic nature of team science, where needs for funding may change as research progresses. Another approach is to give individual researchers access to professional development funds, which can be used to fund collaborations, visit geographically dispersed collaborators, or contribute to the funding of a joint team effort. (Ear-M: Changes to Drive Collaborative Initiatives:)

Recommendation: Incubator grants, seed funding, and other flexible funding schemes incentivize team science at all levels of seniority.

4.4 Funding Pitfalls

A persistent challenge in this arena is the "rich get richer" phenomenon, where funding often gravitates towards well-established scholars, potentially stifling innovation and the exploration of uncharted scientific territories (Laudel 2006). At the same time, funding should be awarded based on merit. The challenge is thus to assess which projects have a high chance of success, without referring to applicants' prior record of funding to do so. Another way to counter this problem is to actively set new directions and priorities for funding, to encourage different scholars to submit novel and potentially groundbreaking research (Braun 1998).

Recommendation: When reviewing funding applications, do not take prior funding success into account to avoid the "Matthew effect". Focus on merit and feasibility. (Ear-M: Enhancements in External Inputs, Training, and Team Building (P))

Another potential pitfall occurs in the reviewing of funding applications. Known limitations of reviews are that they tend to be relatively conservative and biased against interdisciplinary research (Shapiro 2014). To counteract such biases, it is possible to recruit reviewers with a broad range of disciplinary expertise. Diversity in review panels will allow for a more balanced and open-minded assessment of novel and interdisciplinary proposals. In addition, Tilburg University should prime reviewers with information about the importance of novel research approaches, mitigating biases against highly innovative proposals. Review criteria should be expanded to encompass not just the technical and scientific merits but also the collaborative potential of the research team.

Recommendation: When reviewing team science funding applications, ensure diverse panels of reviewers, and prime them to value novelty and interdisciplinarity.

4.5 Leveraging Technology and Infrastructure

(Ear-M: Changes that Enable Individuals to Lower Barriers to Interaction and Teamwork (I))

Information Technology (IT) can facilitate effective collaboration, particularly when teams are geographically distributed. There are several "classes" of IT tools that facilitate remote team work (Olson and Olson 2022). One important class of tools are those that enable digitally mediated communication. At TiU, the Microsoft suite (Outlook, Teams, et cetera) is used - but international collaborators often use different platforms, like Zoom (common in the USA) or WebEx (common in Germany). This can lead to compatibility challenges, and it is important that staff have access to different platforms and know how to use them, if they work with colleagues from different institutions. Dynamic platforms, like Slack, provide space for ongoing in-depth discussion, brainstorming, and idea sharing. A second important class of IT services includes coordination tools, like shared calendars and date pickers. These are essential for synchronizing activities and keeping team members informed of each other's schedules and progress. A third suite of tools are meeting support technologies, including hybrid meeting rooms with large displays and smart cameras. These are already in use at TiU and make hybrid meetings more engaging and efficient. A fourth suite of IT technologies are information repositories, such as databases (e.g., Tilburg DataVerse), file sharing services (e.g., Onedrive, Google Drive), and digital laboratory notebooks (e.g., GitHub/GitLab), facilitate seamless access and collaboration on scientific information. Effective team science benefits from shareable and reproducible workflows (**vanlissaWORCSWorkflowOpen2021a?**), which are being taught at TiU by the DCCs.

One important challenge in IT tools for team science is that team members may not all have access to the same software and services. This challenge can be overcome by making use of free open source software (FOSS) for any critical tasks - like data analysis.

This support might include online repositories for enhancing team science effectiveness and training modules tailored to interdisciplinary collaboration.

4.6 Team Science and the Physical Environment

(Ear-M: Enhancements for a Collaborative Team Environment (I))

The relationship between the physical environment at a university and the facilitation of team science is more nuanced than often assumed. While redesigning the physical space itself might seem like an intuitive approach to promoting collaborative research, there is limited empirical evidence supporting the effectiveness of such redesigns in enhancing team science (Owen-Smith 2013). Changes towards open office plans and flexible work places have met with substantial pushback at Dutch universities, as many academics appear to value a constant, controlled, and quiet working environment. Altering the dynamics of physical proximity among researchers, however, does appear to have an evidence based impact on collaboration. For example, random relocations of researchers were found to inspire new collaborations and breakthrough ideas (Catalini 2018). Even brief periods of co-location can increased the likelihood of collaboration (Boudreau et al. 2012). Anecdotally, one winter, the heating broke at the Reitse Poort building, and the lead author of this report was relocated to the Developmental Psychology department (S building). Spending two days at this department sparked two new collaborations. These findings suggest that while the physical structure of a university environment may not be a significant factor, the strategic placement and movement of people within existing environments can effectively foster inter-disciplinary interactions and team science initiatives.

5 Training and Professional Development for Team Science

(Ear-M: Enhancements in External Inputs, Training, and Team Building (P)) (Ear-M: Changes to Drive Collaborative Initiatives:)

The ability to collaborate effectively in a team context is not a given; it is an important *soft skill* that should be trained and developed. As any colleague involved in teaching can attest: challenges always arise when students are asked to work in groups. When they ask why we assign group work despite such challenges, the answer is often: because learning to work together is an important skill for your professional life. With this in mind, it is important to train staff for effective team science, too. According to research, science teams often address coordination and communication challenges in an ad-hoc manner, resorting to online resources or training (Stokols 2014). To properly prepare scholars for complex scientific and societal challenges, however, requires a well thought out long-term strategy to training and professional development and consistent institutional support (J. T. Klein 2010).

With regard to individual team members, it is important to educate PhD candidates and ECR not only in scientific skills, but also intrapersonal skills (personal development), and interpersonal skills (communication, Vogel et al. 2012). (Ear-M: Enhancements in External Inputs, Training, and Team Building (P)) Aside from training individuals, there is also *team training*, defined as an intervention to improve team performance by teaching necessary competencies. This is distinct from *team building*, which focuses more on interpersonal connections and is generally less effective in comparison (Salas et al. 1999). Section Section 3.1 suggests that team training aimed at developing shared goals and transactive memory systems, as well as exposing teams to various interaction styles, results in more adaptive and flexible teams, thereby improving problem-solving and decision-making capabilities (Vogel et al. 2014). Additionally, methods like positional clarification (explicating each member's role in the team) and modeling (trying on each other's roles) are useful for understanding team roles and tasks. Such training strategies enhance communication, coordination, and knowledge integration in science teams. Related to formative evaluation (Section Section 6.4), team reflexivity training may help teams align with project goals during a project's lifecycle: It involves having team members reflect on past performance to improve future interaction (Gurtner et al. 2007). Finally, online platforms like <TeamScience.net> offer modules and resources to enhance skills in interdisciplinary and transdisciplinary team science. The Toolbox Project is another innovative training intervention designed to facilitate cross-disciplinary communication through philosophical dialogue and probing statements about science.

At present, the TiU HR department offers two trainings for teams: Firstly, the workshop 'Strength-based collaboration'/'(samen)werken vanuit de sterke punten', which involves teams reflecting in how to bring out the best in themselves, increasing self-awareness, and addresses personal (leadership) development. Secondly, the workshop 'Connected leading' involves getting to know team members' communication styles in order to benefit team effectiveness. A key strength of these workshops is that they are targeted towards entire teams, including scientific- and support staff. A potential limitation is that the concept of communication styles is not a focal topic in the scientific literature on training for team effectiveness; specific problem-solving, conflict resolution, and decision making skills are more salient concepts. Low-hanging fruit in terms of additional training to develop is evidence-based training tailor-made to improve team effectiveness (see Section 3.1), including trainings that focus on developing shared goals and representations. One inspiring example is the set of simple and almost gamified conversation guidelines that empower any team to engage in reflexivity and professionalization regarding team goals, recognition and rewards, and impact (Utrecht 2023).

(Ear-M: Changes to Drive Collaborative Initiatives:) **Recommendation**: TiU should offer evidence-based team trainings for team science. This includes training individuals in skills required for effective teamwork, and training teams as a whole to build shared goals and representations.

Recommendation: TiU should develop simple guidelines, readily available to all staff, to help teams engage in reflexivity and professionalization.

5.1 Training Collaborative Competencies and Leadership Skills

(Ear-M: Changes to Drive Collaborative Initiatives:) (Ear-M: Enhancements in External Inputs, Training, and Team Building (P)) (Ear-M: Changes that Enable Groups to Work Together More Effectively (P))

Universities can support university-industry research partnerships and other types of research centers by providing the leaders with formal leadership training, as recommended in Chapter 6. They can also encourage leaders and participants in newly formed research centers or institutes to articulate their expectations through written charters or collaborative agreements (Bennett, Gadlin, and Levine-Finley, 2010; Asencio et al., 2012). Such documents outline how tasks will be accomplished, how communication will take place, and how issues such as finances, data sharing, and credit for publications and patents will be handled." ("Enhancing the effectiveness of team science", 2015, p. 205) (Ear-M: Changes that Enable Groups to Work Together More Effectively (P))[d]

6 Recognition and Rewards

Recognition and rewards are a key driver of desired culture changes. Thus, to promote a transition towards greater team science, TiU should establish clear criteria for the recognition and reward of staff contributions to collaborative research efforts. The dominant perspective in global academia is to perceive team science as the "cherry on top" of individual achievement. Klein and colleagues (2013) summarize this as "Tenure first, interdisciplinarity later," and "Individual reputation first, collaboration later." Such a mindset can significantly hinder the adoptation of a culture supportive of team science. Instead, TiU should clearly communicate that team science is a major ingredient of the "whole cake", not just the cherry on top.

Recognizing and rewarding team science is crucial across all levels of seniority. According to the principle of "doctoral socialization," the academic trajectory of early career researchers is heavily influenced by their supervisors (Austin 2011). Typically, PhD candidates are expected to collaborate only with their direct supervisors, a practice that misses the opportunity for broader engagement in interdisciplinary work. Initiatives like TSB's HSRI PhD grants, which encourage collaboration between supervisors from multiple schools, represent a progressive departure from this norm. There is room to expand this approach further by integrating participation in team science projects as a standard element of PhD programs. Although this requires an investment of the PhD student's time, it benefits the candidates by better preparing them for the job market, expanding their network, and resulting in additional (often higher impact) publications. This is particularly advantageous for early-career scholars. In essence, a systemic shift towards recognizing and rewarding contributions to team science can cultivate a more collaborative, interdisciplinary, and dynamic academic environment, aligning with the evolving demands of contemporary research landscapes.

Recommendation: Task a working group with developing and evaluating general principles and specific criteria for recognizing team science contributions, and transparently incorporate these criteria in vacancies, PT&D conversations, and tenure and promotion committees.

Recommendation: Require PhD candidates to contribute to one team science project during their education.

Recommendation: Establish grants for collaborative PhD projects on thematic topics that require interdisciplinary and inter-faculty team science.

6.1 What to Recognize and Reward?

TiU was a pioneer of the recognition & rewards movement, introducing the *MERIT system*. MERIT was an ambitious and progressive approach to academic performance assessment, encompassing five domains: Management, Education, Research, Impact, and **Team**. However, the system's requirement for excellence across all domains was widely considered to be impractical, leading to the phrase "a sheep with five legs" (employees are expected to be sheep with five legs). While the MERIT system acknowledged contributions other than only individual research excellence, there remained a need for a more nuanced approach, more individualized assessment, recognizing and valuing the unique strengths and contributions of each staff member. At other universities (e.g., Utrecht, who developed the TRIPLE system based on TiU's MERIT system), there is room for employees to *specialize* along several - but not all - of the areas of the model. Such flexibility is important in the light of persistent signals of high work pressure, because it allows staff to focus their efforts in specific areas, like education or research, at different times, thereby reducing the burden of juggling multiple tasks simultaneously.

An important remaining question is how well the MERIT system is aligned with existing university-wide hiring- and promotion policies. If properly implemented, MERIT could create a more diverse range of career tracks, offering tenure and advancement opportunities to those who contribute significantly to departmental and university objectives, beyond the traditional research-focused pathways. This approach could lead to a more inclusive and flexible academic environment, where varied career trajectories are not only possible but also celebrated and rewarded. Some staff have high expectations for "Use (Y)our Talents" to deliver meaningful change, but this requires adjustments at various levels of the university's hierarchy. One anonymous employee said: "I am taking the SUTQ course to specialize more in education [...] If the university takes recognition & rewards seriously, I might still become 'associate professor of teaching' some day". Greater team science affords - and requires - greater specialization of staff members, and in order to facilitate such specialization, it is advisable to embrace and effectively implement a multi-dimensional schema for evaluating employee performance, like MERIT (2.0?).

Recommendation: Adopt the MERIT system as official guiding principle for PT&D, hiring, and promotions at TiU, but allow employees to specialize along its key dimensions, and ask organizational bodies to create vacancies that require a specific profile.

6.2 (Inter)national Developments

Research assessment practices are shifting globally, as a result of the *Declaration on Research Assessment* (DORA). It advocates for a more nuanced approach to assessing scientific research and contributions, rejecting journal-based metrics, such as Journal Impact Factors, as proxies for the quality of individual research articles or the contributions of individual scientists. Instead, DORA advises institutions to clearly communicate the criteria used in hiring, tenure, and promotion decisions, emphasizing that the scientific merit of scholarly output is more important than publication metrics or journal reputation. Institutions are also encouraged to value and consider the impact of *all* research output, including datasets and software, alongside publications, and to adopt a broad range of impact measures, including qualitative indicators of research impact like policy influence. This has resulted in substantial pressures from outside the organization to adopt *some* type of multi-faceted performance assessment, like MERIT: Both NWO and ERC are signatories to DORA, and have adopted the "narrative CV" format for grant applications. The narrative CV is congruent with MERIT; if staff view their performance through the lens of a multifaceted qualitative assessment instrument, they are well prepared to write a narrative for an NWO or ERC application as well. Conversely, if staff are accustomed to quantifying their performance only in terms of traditional metrics (impact factors, H-index, et cetera), they may be poorly prepared to write a narrative CV, and they will have focused their attention on optimizing outcomes that are increasingly omitted from consideration outside of TiU.

Recommendation: To ensure that TiU staff remain competitive in (inter)national funding calls from DORA signatories (e.g., NWO, ERC), which require submitting a narrative CV, TiU should require internal performance reviews to follow a similar narrative structure, focused on quality, instead of relying on metrics with poor validity for assessing individual researchers' performance.

6.3 Crediting Author Contributions

Standards for crediting author contributions to collaborative efforts differ widely across disciplines. Often, authorship order plays a role, but there is no consensus about the meaning of specific positions. Journals increasingly require author contribution statements that outline the scope of each team member's contribution (Cooke, Hilton, and Council 2015).

It is important to fairly and transparently acknowledge each team member's contribution in the creation of any type of research output, while allowing for diversity in attribution, which varies across disciplines and outlets. To account for diversity in attribution, authors can explicitly state what convention was followed to credit contributions (Tscharntke et al. 2007).

Recommendation: Fairly and transparently credit each team member's contribution in the creation of research output.

Recommendation: Explicitly state what convention was followed to credit contributions.

The CRediT contributor taxonomy aims to reduce the ambiguity surrounding authorship (Allen et al. 2014). It recognizes 14 contributor roles, which - while they may not fit all cases - cover a lot of ground. The CRediT contributor taxonomy may serve as a sensible default for all projects, unless another convention for crediting contributions takes precedence.

Recommendation: All research output should be accompanied by a CRediT contributor taxonomy statement, unless another convention for crediting contributions takes precedence, in which case a reference should be provided to the system used.

6.4 Monitoring and Evaluating Team Science

Monitoring and evaluating team science projects is integral to their success. Importantly, such evaluations should not rely solely on output in bibliometric terms, but also in terms of team processes, coordination, and team goals (Hinrichs et al. 2017). There are two relevant approaches to evaluation: formative and summative methods. Formative evaluation focuses on providing ongoing feedback to improve the project in real-time (Vogel et al. 2014; Gray 2008). This is instrumental in identifying areas for immediate improvement and making adjustments in goals, approaches, and team composition throughout the project lifecycle. On the other hand, summative evaluation aims to glean lessons from completed projects that can inform and enhance future programs (Liverman et al. 2013; Vogel et al. 2014). This type of evaluation provides a comprehensive overview of a project's outcomes and effectiveness, offering valuable insights for future endeavors.

Recommendation: All science teams should plan for formative assessments at given milestones during the project lifecycle. TiU should require summative evaluation of team science projects funded by the University (eerste geldstroom).

7 Recommendations for a Vision for Team Science at Tilburg University

1. Team science allows scholars to provide complex solutions to large-scale public challenges. It promotes collaboration, cohesion, and knowledge exchange within organizations, increases impact, and may benefit research quality.

2. Any science team should be aware of, and reflect on how they relate to, the seven challenges of team science: diversity, knowledge integration, team size, goals, permeable boundaries, geographic dispersion, and task interdependence.
3. Team effectiveness is best enhanced by thoughtful team composition, team professional development (including actively working towards shared understanding of goals, task requirements, and team member competences), and inspiring team leadership.
4. Team members should be able to disagree constructively in a safe, supportive context. When possible, preemptive conflict management strategies should be used; anticipating disagreements and establishing terms for their constructive resolution. When conflict does occur, reactive conflict management should focus on empathy, problem-solving, and compromise.
5. Ensure trust within team contexts to facilitate effective collaboration, for example, through procedural fairness and transparency within science teams and the broader organization, and through physical contact between team members.
6. When composing a team, it is crucial to weigh the benefits of *task relevant diversity* against the downsides of overcoming disciplinary, institutional, or demographic differences.
7. There should be a balanced approach to permeable team boundaries, leveraging the benefits of diverse and adaptable membership while maintaining a core of stability and security to foster team cohesion and sustained performance.
8. For all temporary team members, in particular ECR and those on temporary contracts, the balance between investments (in terms of time and effort) and rewards should be explicit and fair.
9. Create a climate conducive to team science by incentivizing collaboration, making hierarchies flexible, supporting autonomy, embracing open science, recognizing and rewarding team science, and providing inspiring team-oriented leadership.
10. "Excellence" does not exclusively refer to individual performance, but also applies to team efforts.
11. In order for team science to flourish, TiU must balance hierarchy and specialization on the one hand with collaboration and integration on the other. Hierarchy must be flexible: it must be possible to check, question, and even challenge authority.
12. To enact a desired culture change towards more team science, a combination of a top-down (through policy, funding opportunities, and recognition and rewards) and bottom-up (through informal networks like the Open Science Community, and social, academic, and networking events) approaches is necessary.

13. Task a working group with developing and evaluating general principles and specific criteria for recognizing team science contributions, and transparently incorporate these criteria in vacancies, PT&D conversations, and tenure and promotion committees.

14. Require PhD candidates to contribute to one team science project during their education.

15. Establish grants for collaborative PhD projects on thematic topics that require interdisciplinary and inter-faculty team science.

16. Adopt the MERIT system as official guiding principle for PT&D, hiring, and promotions at TiU, but allow employees to specialize along its key dimensions, and ask organizational bodies to create vacancies that require a specific profile.

17. To ensure that TiU staff remain competitive in (inter)national funding calls from DORA signatories (e.g., NWO, ERC), which require submitting a narrative CV, TiU should require internal performance reviews to follow a similar narrative structure, focused on quality, instead of relying on metrics with poor validity for assessing individual researchers' performance.

18. Fairly and transparently credit each team member's contribution in the creation of research output.

19. Explicitly state what convention was followed to credit contributions.

20. All research output should be accompanied by a CRediT contributor taxonomy statement, unless another convention for crediting contributions takes precedence, in which case a reference should be provided to the system used.

21. All science teams should plan for formative assessments at given milestones during the project lifecycle. TiU should require summative evaluation of team science projects funded by the University (eerste geldstroom).

22. TiU should offer training and professional development for team science. This includes training individuals in skills required for effective teamwork, and training teams as a whole.

23. Using public funds (eerste geldstroom) to fund team science initiatives can affect more colleagues' careers in a more impactful way, while promoting cohesion within the organization. To do this fairly and transparently, the target audience should be included in the development of funding calls.

24. Applications for team science funding instruments should include a collaboration plan as part of the evaluation criteria.

25. Incubator grants, seed funding, and other flexible funding schemes incentivize team science at all levels of seniority.

26. When reviewing funding applications, do not take prior funding success into account to avoid the "Matthew effect". Focus on merit and feasibility.

27. When reviewing team science funding applications, ensure diverse panels of reviewers, and prime them to value novelty and interdisciplinarity.

8 Appendix A: Members of the working group

Caspar van Lissa (project lead, TSB)

- Associate professor Social Datascience at the department of Methodology and Statistics, TSB
- Chair of the Open Science Community Tilburg
- Board member Tilburg Young Academy
- Experienced in team science: Participated in Data vs Corona, PsyCorona, and a Stanford-based Climate Consortium; established a consortium to develop the Workflow for Open Reproducible Code in Science.

Esther Keymolen (TLS)

, Michiel Besters, Yvonne Vermonden (beiden AS), Sasha van den Hoek, Lilly Schurman, Annika Klingner (student-assistenten), Marjan van Hunnik (E&W) To meet this mandate, the working group used the following methodology: All team members read the book " "

Lilly Schurman

- Student-assistant
- Studying Bestuurskunde
- Student advisor to CvB

Annika Schurman

- Student-assistant
- Studying Human Resources
- Board member of a student association

Sasha van den Hoek

- Student-assistant
- Studying Enterpreneurship & Business Innovation: Minoring in Finance
- Former chairman of Asset Tilburg, and External Affairs of Student Party ECCO.

9 Appendix B: Methodology

9.0.1 Textbook

The core team first read the book “Enhancing the Effectiveness of Team Science”. This book was written by a consortium of world experts on Team Science, and commissioned by the National Research Council, and funded by the National Science Foundation and Elsevier. Its mission was similar to ours.

9.0.2 Systematic Search

The team conducted systematic literature searches from 2015 onwards, to update the knowledge gathered from the book where necessary.

9.0.3 Qualitative Interviews

To gain a better understanding of the status quo of team science at Tilburg University, the core team interviewed members of existing Team Science projects throughout the organization. To gain insight on national best practices, the team additionally interviewed members of notable national Team Science projects, like the YOUTH Cohort Study (UU) and ODISSEI (national).

9.0.4 Publication Practices

Furthermore, the core team obtained and analyzed co-authorship statistics from University Library.

9.0.5 Examples

The core team gathered similar vision documents and guidelines from other Universities, most notably Utrecht University and Leiden University.

9.0.6 Feedback

The core team created Intervision and Feedback opportunities for stakeholders; including a bilateral meeting with Esther Keymolen, who conducted a team science pilot at TiSEM; the Working Group Use (Y)our Talents; and a workshop open to all employees of TiU, but with special attention to the Tilburg Young Academy and Open Science Community.

9.0.7 Integration

The Team Lead, Caspar van Lissa, integrated the results from these different approaches and wrote the final policy brief. # Appendix C: Library Report

· Welk percentage artikelen werd geschreven door auteurs van meer dan één faculteit?

Filters applied: - Category = Scientific - Type = Article - Status = Published - Peer reviewed = Yes - Only schools, no divisions or institutes that fall under the University instead of schools.

Year	X2019	X2020	X2021	X2022	X2023
Articles with > 1 school *	41	30	32	32	21
Total articles **	1078	1134	1150	1161	650
Percentage	3,8%	2,6%	2,8%	2,8%	3,2%

- De school (faculteit) is bekend voor huidige organisaties. Oude of overgenomen organisaties worden niet meegerekend. Wanneer een faculteit samenwerkte met een oude unit van een andere faculteit, wordt deze dus niet als samenwerking meegerekend. Dit komt door een gebrek in de aanlevering van de data vanuit Elsevier. ** Total articles zijn het totaal aantal artikelen waar minimaal 1 faculteit bij betrokken is.

· Welk percentage artikelen had minstens één co-auteur die niet aan deze universiteit verbonden was?

Filters applied: - Category = Scientific - Type = Article - Status = Published - Peer reviewed is Yes

Year	X2019	X2020	X2021	X2022	X2023
Articles with > 0 external persons *	739	785	781	786	436
Total articles **	1135	1188	1192	1202	655
Percentage	65,1%	66,1%	65,5%	65,4%	66,6

- Externe personen worden geteld als extern wanneer ze NIET verbonden zijn met een (bekende) interne TiU organisatie, maar wel verbonden met een externe organisatie. ** Total articles zijn het totaal aantal artikelen, ongeacht of er een faculteit bij betrokken is.

· Welk percentage artikelen had minstens één co-auteur die aan een pivate instelling (geen universiteit) verbonden was? Filters applied: - Category = Scientific - Type = Article - Status = Published - Peer reviewed is Yes - Type of external organization is not: 'Academic', 'University', 'Unknown' External organization with types that are counted: o Government o Research Institute o Company o Corporate o Medical o Broadcasting organisation o Private non-profit

Year	X2019	X2020	X2021	X2022	X2023..20.11.
Articles with > 0 private organization persons *	214	221	187	212	112
Total articles **	1135	1188	1192	1202	655
Percentage	17,0%	16,3%	13,3%	15,1%	14,5%

- Externe personen worden geteld als extern wanneer ze NIET verbonden zijn met een (bekende) interne TiU organisatie, maar wel verbonden met een externe private organisatie. ** Total articles zijn het totaal aantal artikelen, ongeacht of er een faculteit bij betrokken is.

[a]Paragrpahs that are enclosed in are comments. I have seen your edits here, and re-inserted them in the relevant sections below. [b]Paragrpahs that are enclosed in are comments. I have seen your edits here, and re-inserted them in the relevant sections below. [c]add abc's of team work here (for annika) [d]Still needs writing; who has notes about leadership training?

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