

Interdisciplinarity in light of Actor-Network Theory

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ABSTRACT

The Norwegian University of Science and Technology has begun a major campus development project with ambitious goals such as promoting innovation, collaboration, and knowledge development. Interdisciplinarity is seen as an important approach to achieve these goals. There are multiple factors that might influence interdisciplinary work, such as organisational, cultural, technological, and physical factors, and there is a need for an approach to discuss all these factors in context. This paper will examine the concept of interdisciplinarity and whether Actor-Network Theory (ANT) can be a useful approach when it comes to shaping an academic community. A literature study was performed to investigate what existing literature says about interdisciplinarity and the different factors influencing such work. Further, it investigates if interdisciplinarity can be discussed towards ANT and if this can help expand the discussion on interdisciplinary work further. The findings in this paper show that multiple factors might influence interdisciplinary work. Actor-Network Theory is an interesting approach since it looks at how both tangible and intangible factors interact. Organisational, cultural, and technological factors and the physical space must be seen in relation to each other to get the full effect of the different factors to achieve interdisciplinarity. The findings in this paper can be helpful to further develop the discussion and understanding of interdisciplinarity. Putting the different factors influencing interdisciplinarity in a context it might help planners and designers to get a more holistic picture of how to promote innovation in for instance campus development projects.

Keywords

Interdisciplinarity, Interdisciplinary, Actor-network theory, ANT, Campus development.

1 INTRODUCTION

The Norwegian University of Science and Technology, NTNU, has begun a large campus development project. The project has ambitious goals such as promoting innovation, collaboration, and knowledge development to contribute to solving the challenges our society is facing, like the climate crisis, poverty, health, pandemics, and issues regarding all three dimensions of sustainability. These issues are viewed as too complex to be solved by one discipline alone, and therefore academics and researchers must work together across disciplines. Interdisciplinarity is a term that already is widely used in academia, as well as in other sectors. It is often understood as equal to collaboration which is a quite limited understanding. Interdisciplinarity is often mentioned as an important part of innovation and creativity and provides opportunities to generate new ideas or develop new approaches and solutions.

How can traditional academic practice, working mainly in their disciplinary silos, be changed to shape new academic communities and networks across disciplines? There are multiple factors, e.g., organisational, cultural, technological, and physical that play a role in achieving these goals. Therefore, there is a need for an approach that makes it possible to discuss all these aspects in context. This paper will elaborate on the concept of interdisciplinarity, and factors that might influence interdisciplinary work. Further, the paper aims to investigate whether

Actor-Network Theory can be a useful approach to examine the concept of interdisciplinarity when shaping an academic community.

2 THEORETICAL FRAMEWORK

This section will present the theoretical framework regarding interdisciplinarity, factors influencing interdisciplinary work and actor-network theory.

2.1 Interdisciplinarity

Stember (1991) stated that the influence of academic disciplines is dominant in universities. Colleagues are organised by departments of separate disciplines, identity and career development of faculty are enhanced by disciplinary guilds and professional associations, and students are expected to specialise in one discipline. Today, more than thirty years later, universities are still structured into faculties and departments, and employees and students are still strongly related to their own academic disciplines. Even while disciplines serve a useful purpose, the academic disciplines create barriers to the university's sole purpose (Stember, 1991). The world is facing challenges that are too complex or too broad to be handled by one discipline alone, and therefore researchers need to work together across disciplines. These challenges include comprehensive topics such as the climate crisis, energy crisis, pandemics, poverty, and issues regarding all three dimensions of sustainability etc. Interdisciplinarity is often understood as equal to collaboration, which is a fairly simplified interpretation of the term, but the heightened interest in teamwork to solve complex problems has helped to reinforce connections between disciplines (Klein, 2010). Working across academic disciplines can help facilitate the development of new, creative, and innovative approaches, which can provide opportunities to e.g., generate new ideas, develop new approaches and methods, as well as eliminate oversight and errors in monodisciplinary practice (Reich & Reich, 2006). Since the 1960s, interdisciplinarity has been a major topic in academic and policy-oriented discourse on knowledge production and research funding (Huutoniemi et al., 2010). The first major set of terminology was developed in the 1970s. In a report published in 1972 by the Organization for Economic Cooperation and Development (OECD), they classified interactions of disciplines into multi-, pluri-, inter-, and trans-disciplinarity (Klein, 2017). There are many nuances to interdisciplinary work, and the categories mentioned above involve various steps of cooperation and coordination between disciplines (Jantsch, 1972). Disciplinarity is specialisation in isolation, a mono-discipline, it describes that someone can study something within a discipline, without needing knowledge about another discipline. Multidisciplinarity describes a situation where a problem is approached from a variety of disciplines, but with no cooperation or integration (Max-Neef, 2005). Pluridisciplinarity is when there is cooperation between a variety of disciplines that are assumed to be more or less related, but with no coordination between them (OECD, 1982). OECD (1982, p. 23) described interdisciplinarity as:

An adjective describing the interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data and organisation of research and education in a fairly large field. An interdisciplinary group consists of persons trained in different fields of knowledge (disciplines) with different concepts, methods, and data and terms organised into a common effort on a common problem with a continuous intercommunication among the participants from the different disciplines. Right off the bat, interdisciplinarity seems like a no-brainer. Coordinated collaboration across disciplines to further develop knowledge sounds easy enough, but it is not as easy as it sounds. Interdisciplinarity has multiple challenges, and such work is more complicated than it seems. There are many reasons for working interdisciplinary, but there are some issues that cannot be

resolved just by adding disciplines together, or just by placing specialists from different disciplines together, and the greatest barrier to interdisciplinarity is often methodological (Lindauer, 1998). Some academic disciplines might be more interdisciplinary than others by the nature of their academic practice, and to cross e.g., the humanities and the sciences can pose a greater challenge than crossing internally within the humanities or the sciences (Stember, 1991).

Stember (1991) suggested some strategies to consider before embarking on an interdisciplinary project, to help make interdisciplinary work a little easier to handle. The first step is to select the appropriate members and leaders for the project, commitment and a common interest in the project are crucial to the success of an interdisciplinary project. Second, it is important to establish some ground rules, such as scheduling meetings, publication arrangements etc. To uncover and discuss differences in methodology participants should present how they can contribute and their discipline's viewpoint early in the project, this also helps the different contributors to recognise and appreciate that different disciplines have different ways of working. Lastly, there is a need for infrastructural support. Interdisciplinary projects might need an allocated space, and this might vary from just a dedicated room, a laboratory, or a larger structure where researchers and students from different disciplines can work together.

2.2 Factors influencing interdisciplinary work

Several factors need to be present to facilitate interdisciplinarity in universities, e.g., organisational, cultural, technological, and physical factors. Organisational factors regard how the organisation is organised and financed and how it facilitates the core activities that are being carried out, as well as the organisation's infrastructure. These factors are important because it sets both the limitations and the possibilities for what the researcher can do, and the frameworks put up here will decide how easy or difficult it can be to work interdisciplinary (Stember, 1991). "Individual researchers involved in interdisciplinary research (IDR) require a supportive environment that permits them to work in multiple disciplines and departments and to be fairly evaluated and rewarded for both their interdisciplinary and their disciplinary work." (National Academy of Sciences et al., 2005, p. 61).

Cultural factors are important as they represent the values and ideologies of a group. Commitment to a common interest including some ground rules is crucial for a project to succeed (Stember, 1991). Many researchers are closely linked to their academic discipline, and in a university, it can be cultural factors within a study program, research group, departments and so on. Cultural factors also include the language and methodological approach of the disciplines, which is natural from their discipline's research traditions (Reich and Reich, 2006). To uncover and discuss differences in methodology is crucial to help the different contributors recognise and appreciate that different disciplines have different ways of working (Stember, 1991).

The fast development in technology in the last decades has made employees more mobile, and now it is possible to work anywhere at any time (Weijs-Perrée et al., 2018). This has also made it possible to communicate with colleagues all around the world (Blakstad, 2015). Hence, technological factors provide great opportunities to increase the amount of interdisciplinary work. Since the outbreak of COVID-19 in March 2020 researchers all over the world have had to occasionally work from home, and technology made it possible to keep up much of the research activities from employees' home offices. Technological factors include everything from specialised laboratories, 3D technology, the internet, whiteboard, phones, computers etc. Physical factors such as buildings, space, and physical artefacts can either support or hinder what an organisation wants to achieve (Blakstad et al., 2008). The need for infrastructural support is important to recognise. One should not underestimate the scope and costs of a project, especially when it comes to interdisciplinarity. Such projects might need different

kinds of allocated space such as laboratories or rooms dedicated to a certain purpose (Stember, 1991). Having colleagues nearby and with a short distance to travel to discuss new ideas face to face with colleagues is important for sharing knowledge (Weijs-Perrée et al, 2019). However, organisational, cultural, and technological factors and the physical space must be seen in relation to each other to get the full effect of the different means to achieve interdisciplinarity (Blakstad, 2015).

2.3 Actor-Network Theory

Actor-Network Theory, hereafter ANT, was developed during the 1980s, and the sociologists Bruno Latour and Michel Callon was in the forefront of this development. An actor-network seeks to define and describe the relational ties between both human and non-human elements, and in line with its semiotic origin, ANT grants all entities in a heterogeneous network the same explanatory status (Monteiro, 2000). Who are the actors, and what are the networks? According to Latour, the term actor should be understood in the same way as the term actant is used in semiotic (Latour, 1996, p. 7): An “actor” in ANT is a semiotic definition – an actant – that is, something that acts or to which activity is granted by others. It implies no special motivation of human individual actors, nor of humans in general. An actant can literally be anything provided it is granted to be the source of an action.

By this definition, Latour explains that the term actor does not only apply to human actors, as it usually is in the traditional understanding of the term. It also applies to non-human actors, which can include everything that is made to act (Fallan, 2008). ANT prescribes agency to objects, and thereby claims that human actants and technological actants have the same amount of agency, and therefore they are equally important to the network they are in (Fallan, 2008). Thereby, the term can include concepts, objects, technology etc.

When two or more actors are connected, they will create an actor-network. According to Fallan (2008, p. 83) “Networks are made up by associations and constituted by the effects of the enrolled actors.”. Latour (2005, p. 131) specifies that “Network is a concept, not a thing out there. It is a tool to help describe something, not what is being described”.

Monteiro (2000, p. 75) describes how an actor-network works: [...] All of these factors are related or connected to how you act. You go about your business not in a total vacuum but rather under the influence of a wide range of surrounding factors. This act you are carrying out and all of these influencing factors should be considered together. This is exactly what the term ‘actor network’ accomplishes. An actor network, then, is the act linked together with all of its influencing factors (which again are linked), producing a network.

Translation, or Sociology of translation, was introduced by Michel Callon in 1986. Its purpose is to align objects or the networks in which the objects are in towards a certain target. To use translation is appropriate when analysing how actor networks are created and how they are developed and maintained (Callon, 1986). Latour (1994, p. 32) wrote: “[...] I use translation to mean displacement, drift, invention, mediation, the creation of a link that did not exist before and that to some degree modifies two elements or agents.”. Callon (1986) describes translation as a process of four phases, or ‘moments’, which can overlap: problematization, interessement, enrolment and mobilization. Problematization is when an actor offers a problem statement and seeks to engage other actors to find the solution. This problem must be interesting for the other actors to create a collective interest. Interessement is when researchers, or other actors, try to impose and stabilise the identity of the other actors it defines through its problematization. If interessement is successful it will lead to enrolment, which is about designating a set of interrelated roles and attributing them to the actors who accept them. It is in the enrolment phase that the definition and distribution of roles are being tested, and it is crucial to have clear roles and motives to who is doing what, so that the actors accept the roles, and join the network. Mobilization is the last phase in the translation process and defines who speaks in the name of

whom. Who is the speaker of the network, and who is writing the scientific articles on behalf of the group? (Callon, 1986). The spokesperson must act according to the network's interests, and this is a test of how strong the network is (Wæraas and Nielsen, 2016).

3 METHODOLOGICAL APPROACH

This paper is mainly a theoretical paper based on a literature study looking at the main topics "Interdisciplinarity" and "Actor-Network Theory". The search engine Google Scholar was used and search the terms used were "interdisciplinary", "interdisciplinarity", "transdisciplinarity", "actor-network theory", and "ANT". Much of the literature can be perceived as old since it is from the 1970-80s. When reading newer literature these sources were used in them as well, therefore old literature was not perceived as an issue. More recent literature has also been used for this paper. For the author's PhD-project 10 interviews with academic staff from different departments at NTNU were conducted. Some of the questions regarded interdisciplinarity and the informants' experiences and thoughts about it. The interviews are presented in the findings to illustrate some of the challenges with interdisciplinarity in practice, and which factors they brought forward that support or hinder such work. The interviews were semi-structured, so it offered the informants the ability to speak freely about their experiences.

4 FINDINGS FROM INTERVIEWS

From interviews conducted with academic staff from different departments at NTNU, it became clear that one of the greatest barriers to interdisciplinary work is organisational. According to all informants, there are many systems to go through to be able to work with colleagues outside their own department. These systems are bureaucratic and related to for instance financing, where should the hours be billed, who is getting the points for publications etc. These administrative tasks take up valuable time of the researcher's day, and many researchers thereby view the costs as larger than the outcome of the project. Some informants also mentioned large differences in methodological, and theoretical approaches, as well as differences in the department's professional language as challenging. This was especially prominent between the humanities and the sciences. Multiple informants explained that their disciplines are interdisciplinary by nature and that they can work interdisciplinary with almost all disciplines, while other informants describe their practice as too specialised, so it is challenging to work interdisciplinary. One informant from the sciences could not ever imagine working interdisciplinary with someone from the humanities, because they, according to the informant, did not have anything in common at all. This is a culture that has been set in the informants' discipline and thereby excludes many great opportunities for interdisciplinary work. This is an example of how cultural factors influence interdisciplinary work. Other informants mentioned the physical distance between the university's campuses as a barrier to interdisciplinarity and hopes that the co-location of the two largest campuses will help facilitate more interdisciplinary work. The informants that already are working on interdisciplinary projects explained that few of the projects took place internally at the university, but rather with industry or other universities outside Norway. The latter is made possible by technology that helps them communicate across borders.

5 DISCUSSION

This section will discuss the concept of Interdisciplinarity in light of Actor-Network Theory to investigate if ANT can help organise the different factors influencing such work, in an attempt to understand the process of interdisciplinarity in a better way.

The literature explained that interdisciplinarity is an important approach to solving complex problems and working together across academic disciplines provides opportunities to generate new ideas and develop new approaches and methods (Reich & Reich, 2005; Klein, 2010). The jungle of terms and nuances regarding interdisciplinarity might seem confusing, both for researchers who are working with interdisciplinarity as a concept and for the researchers who are trying to work interdisciplinary. ANT is developed to methodologically analyse connections between social and technological elements. The actors might be human or non-human, and ANT seeks to define and describe relational ties between these elements (Monteiro, 2000).

Callon's (1986) method of Translation and Stember's (1991) strategies for interdisciplinary work can be helpful to get a systematic approach to the analysis of the different factors influencing interdisciplinarity, as well as working systematically with problematization, interessement, enrolment, and mobilization. As stated, many factors influence interdisciplinary work, and this paper addressed the physical, technological, organisational, and cultural factors. An analysis of how these factors connect to and interact with each other can help facilitate interdisciplinarity. The interviews found that one of the greatest barriers to interdisciplinarity is organisational, and often related to financial systems within the organisation. Second, there are cultural differences between the disciplines, often related to methodological and theoretical approaches, as well as language, which Lindauer (1998) mentioned as the greatest barrier to interdisciplinarity. There are variations across the disciplines and some disciplines are interdisciplinary by nature, while others are more monodisciplinary, which is natural because of their disciplines' research traditions.

Attitudes towards different academic disciplines can be linked to the discipline's culture. Stember (1991) mentioned the two "opposites" (humanities and sciences) as examples of disciplines that might struggle to work together, most likely because of the large methodological differences between them. One informant said in their interview that they would rather work with other disciplines within technology, even outside national borders, rather than work with someone from the humanities. This is not because of the people, but because of their methodological approaches and the large differences between their theoretical perspectives. These are just two examples, but both should be more manageable if the organisation is aware of these challenges. The organisation should have systems in place to make it easier to work across disciplines and departments without all the bureaucracy, and time spent on unnecessary administration to figure out e.g., where to bill the hours.

Both the theory and the findings from the interviews illustrate that interdisciplinary work is dependent on a long list of factors that need to interact with each other, and it might be challenging to identify all of them. ANT is an interesting approach since it looks at how both tangible and intangible factors interact. The act linked together with all influencing factors creates the actor-network (Monteiro, 2000). In a campus development process, the focus tends to be on the physical design of buildings and the infrastructure, while the other less concrete or visible factors like social relations or values are not always as easy to recognise and thereby, they are easier to forget or ignore, and not be systematically attended to during the process (Blakstad et al., 2008). ANT can be useful to identify and organise which factors must be present to facilitate interdisciplinarity. These factors might vary from discipline to discipline.

6 CONCLUSION

Interdisciplinarity is important and working together across disciplines increases the opportunities to e.g., generate new ideas and methods and to help innovation. To make it easier for researchers to engage in interdisciplinary activities the location and design of campus buildings will be important. To facilitate more interdisciplinarity, physical, organisational,

cultural, and technological factors must be present and understood, such as financing and administrative systems, which needs to be less rigid.

Actor-Network Theory might be useful to understand the processes of interdisciplinary work, and to illustrate which actors, both human and non-human, are engaged in such activities. Analysing successful interdisciplinary projects and looking at the connections between the actors in the project, or network, can uncover elements or success factors in the process which can contribute to forming a model or description of the processes in an interdisciplinary project. On the other hand, no projects are alike, so making it general enough to be applied to multiple projects poses a challenge.

ANT can be a helpful approach for planners, architects, and designers, as well as organisations, to see how the process of interdisciplinarity unfolds, and to identify factors that need to be present and/or influence interdisciplinary work. And by knowing this, being able to design buildings and spaces that encourage this type of work for both researchers and students, and if the facilities are inviting and facilitate interdisciplinary activities, we are one step further in shaping an academic community.

REFERENCES

- Blakstad, S. H., Hansen, G. K., Knudsen, W. (2008), Methods & tools for evaluation of usability in buildings. In: *Usability of Workplaces, Phase 2*, Edited by: Alexander, K. Rotterdam: International Council for Research and Innovation in Building and Construction. CIB W111 Research Report
- Blakstad, S. H. (2015), Work isn't where it used to be, in Ropo, A., Salovaara, P., Sauser, E., De Paoli, D. (Eds), *Leadership in Spaces and Places*, Elgar Cheltenham.
- Callon, M. (1986), Some elements of a sociology of translation domestication of the scallops and the fishermen of St. Brieuc Bay, *The Sociological Review*, 32(1), pp. 196-223. doi: <https://doi.org/10.1111/j.1467-954X.1984.tb00113.x>
- Fallan, K. (2008), Architecture in Action: Traveling with actor-network theory in the land of architectural research, *Architectural Theory Review*, 13(1), pp. 80-96. doi: <https://doi.org/10.1080/1326482080918306>
- Huutoniemi, K., Klein, J. T. Bruun, H., Hukkinen, J. (2010), Analyzing Interdisciplinarity: Typology and Indicators, *Research Policy*, 39(1), pp. 79-88. doi: <https://doi.org/10.1016/j.respol.2009.09.011>
- Jantsch, E. (1972), Inter- and transdisciplinary university: A systems approach to education and innovation, *Higher Education*, 1(1), pp. 7-37. doi: <https://doi.org/10.1007/BF01956879>
- Klein, J. T. (2010), *A taxonomy of interdisciplinarity*, in Frodeman, R., Klein, J. T. & Pacheco, R. C. S. (Eds.) *The Oxford Handbook of Interdisciplinarity*. Oxford: Oxford University Press, pp. 15-30.
- Klein, J. T. (2017), Typologies of Interdisciplinarity, the Boundary Work of Definition, in Frodeman, R. Klein, J. T., and Pacheco, R. C. S. (Eds.) *The Oxford Handbook of Interdisciplinarity*. Second edition. Oxford: Oxford University Press, pp. 21-34.
- Latour, B. (1994), On technical mediation: Philosophy, sociology, genealogy, *Common knowledge*, 3(2), pp. 29-64.
- Latour, B. (1996), On actor-network theory: A few clarifications, *Soziale Welt*, 47(4), pp. 369-381. Retrieved from: <http://www.bruno-latour.fr/sites/default/files/P-67%20ACTOR-NETWORK.pdf>
- Latour, B. (2005), *Reassembling the Social. An Introduction to Actor-Network Theory*. Oxford: Oxford University Press.

- Lindauer, M. S. (1998), Interdisciplinarity, the psychology of art, and creativity: an Introduction, *Creativity Research Journal*, 11(1), pp. 1-10. doi: https://doi.org/10.1207/s15326934crj1101_1
- Max-Neef, M. A. (2005), Foundations of transdisciplinarity, *Ecological Economics*, 53(1), pp. 5-16. doi: <https://doi.org/10.1016/j.ecolecon.2005.01.014>
- Monteiro, E. (2000), Actor-network theory and information infrastructure. In *From control to drift: The dynamics of corporate information infrastructures* (pp. 71-83). Oxford: Oxford University Press.
- National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2005), *Facilitating Interdisciplinary Research*. Washington DC: The National Academies Press. DOI: <https://doi.org/10.17226/11153>
- OECD (1982), *The university and the community: the problems of changing relationships*. Paris: Organisation for Economic Co-operation and Development.
- Reich, S. M., Reich, J. A. (2006), Cultural Competence in Interdisciplinary Collaborations: A Method for Respecting Diversity in Research Partnerships, *American Journal of Community Psychology*, 38(1), pp. 51-62. doi: [https://doi.org\(10.1007/s10464-006-9064-1](https://doi.org(10.1007/s10464-006-9064-1)
- Stember, M. (1991), Advancing the social sciences through the interdisciplinary enterprise, *The Social Science Journal*, 28(1), pp. 1-14. doi: [https://doi.org/10.1016/0362-3319\(91\)90040-B](https://doi.org/10.1016/0362-3319(91)90040-B)
- Weijs-Perrée, M., van de Koeving, J., Appel-Meulenbroek, R., Arentze, T. (2018), Analysing user preferences for co-working space characteristics. *Building Research & Information*, 47(5), pp. 534-548, doi: <http://doi.org/10.1080/09613218.2018.1463750>
- Weijs-Perrée, M., Buck, L., Appel-Meulenbroek, R., Arentze, T. (2019), Location choices of face-to-face interactions in academic buildings: an experience sampling approach. *Ergonomics*, 62(12), pp. 1499-1514. doi: <http://doi.org/10.1080.00140139.2019.1660419>
- Wæraas, A., Nielsen, J. A. (2016), Translation Theory ‘Translated’: Three Perspectives on Translation in Organizational Research, *International Journal of Management Reviews*, 18(3), pp. 236-270.