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A REVIEW ON ACTOR-NETWORK THEORY AS A POTENTIAL TOOL FOR ARCHITECTURAL STUDIES[1]

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Abstract

Actor-Network Theory (ANT) is an ontological approach, emerging from science and technology studies. As an ontological frame, ANT proposes that the work of science does not differ from other social processes, and sociality should not be understood as a priori knowledge. Instead, ANT offers a lens to see science as an assemblage of social, technical, conceptional, and textual processes entangled with human and non-human entities by looking at their material nature. ANT proposes to follow traces of material relations and how that material nature constitutes social. There has been a considerable increase in the threshold of ANT and Architecture studies. ANT seems to offer new perspectives to understand architecture by looking at architecture from its own material reality. Thus, this study aims to reveal the whole picture of the studies in the threshold of ANT and architecture by analyzing ANT concepts implemented in architecture. By relating ANT concepts to the architectural field, this systematic review aims to understand ANT and its implications of architectural studies. Visualizing the relations of ANT and architecture related categories, the review is supposed to reveal gaps and the most studied fields of ANT in architecture.

Keywords: Actor-Network Theory, Architecture, Material Reality, New Materiality, Architectural Materiality

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1. Introduction

Architecture has been dominated by human-centered and user-centered paradigms since the mid-1980s. Technological progress and environmental studies have been navigating designers and architects to reconsider the idea behind the built environment and to understand the complex socio-technical systems against classical social theories. Classical social theories claim that knowledge is an active process in response to environmental stimuli. On the contrary, social constructivists reject the individual mind to represent reality and declare that most of our knowledge comes from a consensus of communities. Social constructivist, starting with examining the social construction behind the scientific facts, Callon (1986), Law (1986), and Latour (1988b) have discovered that even the scientific facts are social constructions. Actor-Network Theory (ANT) has emerged from the social studies of science as an ontology to look at things. Architecture and design are also affected by this epistemological turn.

The so-called modern constitution has set nature and culture as two separate ontological provinces by constructing a gap between them. Therefore, two separate fields have occurred to generate different methods for understanding both human beings as culture and non-humans as nature (Latour, 2005, 2008; Whitehead, 2018). Hence, ANT is constructed upon questioning these dichotomies of modernization such as nature and culture, human-non-human, action-structure, subject-object, micro-macro, minor-major, inside-outside (Demerritt, 1996; Murdoch, 1998; Whatmore, 1997). To be able to overcome these dichotomies, ANT focuses not merely on the subject but on the actors and networks by following the traces of action (Latour and Porter, 1993; Latour 2005, 2008). Tracing action is one of the main tenets of ANT because, in ANT's point of view, actions reveal the nature of networks and multiplicity of ways that relations have occurred (Law, 2008a) and how the materials of the world emerge in particular locations at a particular point of time (Law, 2008b).

The studies in the threshold of architecture and ANT have been increasing, yet there is no study to reveal a comprehensive look to associate ANT with architectural theory. Thus, the main aim of this article is to conduct a literature review to evaluate the emerging concepts of ANT in architectural theory and their relations with architectural discussions due to the detected gap in the literature. The review is answering the following questions: What are the emerging concepts of ANT in architectural studies? How can architectural theory associate with emerging concepts of ANT? What are the issues and discussions? Can ANT help scholars to understand the materiality and relationality of architecture?

In order to answer these questions, firstly, the research will be conducted according to two main research themes. They are "Actor-Network Theory" and "Architecture" studies (book chapters, theoretical and primarily case studies). These will be analyzed and classified according to their concepts of ANT and the architectural field with the content reading method. Content reading is a research method that helps to construct a systematic and objective means to transport deductions from the data (text, visual, etc.) in order to depict and evaluate specific phenomena. Relating the categories to the context or environment of the data with meanings and context, it helps to improve the inferential quality of the outcome (Krippendorff, 1980). The content analysis consists of the following steps: creating and defining the categories according to the context and environment, testing the category definitions and rules, reusing coding when necessary, coding all the data, and reevaluating reliability and validity (Krippendorff, 1980). Thus, ANT concepts are determined according to the findings of these studies. If the studies focus on the design process of architecture and find out that the design process is an assemblage of various actions, the ANT concept will be classified as "assemblage," and the architectural field will be determined as "architectural design" (as shown in Table 1). Furthermore, if the studies focus on particular sub-categories of design such as "user behavior," the code will be "user behavior." The studies focusing on the construction process or material fabric of the building are classified as "construction and architecture," while studies investigating different user behaviors or interactions around a building are classified as "user behavior in architecture." The studies investigating the design process of a building are gathered under the theme of "architectural design," while studies discussing nature and architecture relations are assembled under the theme of "architecture and environment." Furthermore, research revealing the sociality, actions,

conditions, or negotiations that emerge around a building is classified as 'architecture and social," while the studies conducted on buildings and their power to act or mediate are classified as "architecture and materiality." Lastly, the studies focusing on different emotional experiences that emerge while experiencing the building are classified as "architectural experience," while the studies focusing on renovation or restoration processes or notion of heritage are classified as "renovation, restoration."

Table 1. Classification of ANT studies according to their focus in architectural field

Focus of the Studies	Architectural Field
The construction process, material fabric	Construction in Architecture
User behavior, Interactions	User behavior in Architecture
The design process, physical model, scale studies	Architecture and Design
Nature and architecture relations	Architecture and Environment Studies
Sociality, sociality power of architecture, negotiations, actions around a building	Architecture and Sociality
Building's power of action, mediate	Architecture and Materiality
The emotional experience of building	Architectural Experience
Renovation, restoration processes, heritage	Renovation and Restoration

Due to the novel nature of ANT, implications of it in the field of architecture dates back to 2005. A total of 38 studies (shown in tables in each section) are analyzed and listed according to their themes and concepts. Afterward, a model of relations of these concepts and themes is visualized in Gephi (a visualization software) to reveal the studies of ANT and its relations to architectural theory.

This literature review intends to fill the gap by exploring the emerging concepts in the intersection of ANT and architecture by looking at the literature as a whole picture. It presents potential research areas, knowledge gaps demanding further investigations, and the most studied areas and the least.

The structure of the paper is designed by starting with an introduction of ANT in the first chapter, its concepts, and ontological point of view. In the second part, emerging concepts of ANT and the architectural field have been revealed. In conclusion, current challenges and discussions is determined for further investigation.

2. Ontology of Actor-Network Theory

The actor-network theory emerges from science and technology studies by Callon (1986), further enhanced by Law (1986) and Latour (1988b). Law (1986) and Latour (1988b) discover that things that are supposed to be scientific facts are social constructions, and their materiality constitutes a considerable gap between nature and culture. Latour (1988b) problematizes the ontology of constructed scientific facts and offers a new ontology to understand society and nature by naming this theory Actor-Network Theory. Thus, ANT deals with presumptions about knowledge construction and dichotomies by the modern constitution (Law, 1986; Latour, 1988b) and offers actor-networks constructed upon materiality and heterogeneity. Therefore, this section of the paper will focus on ANT's understanding of knowledge, the problem of sociality, and the notion of actors and networks.

2.1. Construction of science and problem of sociality

The leading research orientation in contemporary science and technology studies points out that knowledge is a product of social relations and, thereby, is controversial (Collins, 2010). The methodological imperatives of scientific production focus on the agencies by people, ideas, power, and interests in specific places and times to produce knowledge, which constitutes authority on the society (Collins, 2010). To give an illustration, Callon's (1986) study with fishers of Brieuc Bay reveals how social and natural reality is a result of the generalized negotiation. Callon (1986) has ethnographed the production of knowledge during the process of discussions

commissioned about the domestication of scallops and found that knowledge is a product of that process of discussions. Considering the power studies in terms of the sociology of science, Law (1986) also suggests that even scientific facts are constructed upon sociology. Furthermore, the most fundamental contradiction of scientific knowledge is that its social explanation is perceived as prescriptive rather than explanatory and descriptive, as a form of culture and an extension of the function of social life. Furthermore, Shapin and Schaffer (1985) proved that conflicting demands of social knowledge mediate social and scientific knowledge.

According to Latour (2005), the problem was the sociologist's view of "social" as a domain that could account for the state of affairs and also some scientists who add the adjective "social" to the phenomenon that specifies some state of affairs. Latour (2005) defines this problem of sociality in two conditions: first is a movement during the process of assembling and a type of material, an adjective like wooden or steel, a material nature that provides a social explanation of some other state of affairs. Due to scientific and technological improvement, the notion of sociality has undergone many transformations (Latour, 2005). Thus, social must be reinvented (Latour, 2005; 1988b). To understand and reinvent it, Latour (2005) investigates the meaning of social by tracing the etymological roots. As a Latin word, "-sequi" means "-to follow", like a companion and an association. Because of this ambiguous meaning, the word makes someone think about humans (Latour, 2005). However, given an example, de Candolle (1821) investigated that corals and baboons, trees, and bees are also social. By defining sociality as an association, ANT offers to focus on the inner logic of associations that possibly explains the features of that association being together (Latour, 2005) regardless of being human or non-human. Actor-network theorists have focused on all the elements assembled in a building and tried to reveal those elements in the network of the building (Law, 1992).

From the ANT lens, social is assembled into being by actors and networks, including both human and non-human. It is crucial to define the social as a fluid entity that becomes only visible when new associations are being made (Latour, 2005). This fluid entity is also thought to be the potential of the possibility of actors' actions each time they get in a relation (Emirbayer and Mische, 2012) and the material resistance that shapes other actors to move (Latour, 1996). In Latour's view, social order, power, scale, even hierarchy are combined and preserved by material objects. Materials solidify social relations and allow these relations to resist through space and time (Murdoch, 1998). Thus, the theory seeks to analyze how social and material processes (subjects, objects, and relations) become seamlessly entwined within complex sets of associations.

2.2. Matter of fact and matter of concern and the disenchantment of the modern world

The invention of laboratory facts in the 17th century resulted in the birth of empiricism that constructed a clear-cut distinction between the human mind and sensory experience. From John Locke's "blank slate" (Uzgalis, 2020), to Galileo's exploration of the sun-centered planetary system (Machamer, 2017), and to Kant's notion of "a priori" position of mind (Rohlf, 2020), the pure positivist position has been strengthened. For centuries, science and technology have been conducted upon this clear distinction of "matters of fact" and "matters of concern" (Latour, 2014). According to Latour, "matters of fact" are laboratory facts born from experimental physics. The second reality is "byplay of the mind" (Whitehead, 2006), which means "matters of concern" (Latour, 2014). Thus, ANT tries to reunite two distinct realities of nature and culture by referring to Whitehead's (2018) central philosophical doctrine of the world, which describes the world as composed of independent processes and events contrary to the common belief of them to be independently material things (Latour, 1996). Accordingly, ANT offers new ontology by focusing on actors-networks which removes the boundaries between social and natural, human and non-human entities by disregarding modern dichotomies (Latour, 2005) and tracing the processes of things and their traces left behind (Law, 2008a). ANT proposes a network system as a tool to designate the flow of translations (Latour, 1996) as an assemblage of interaction that is embedded in time and space, overflowing with many ingredients to other spaces and other agents (Latour, 1996).

2.3. Actors, networks and the continuing dichotomy of things

An actor is thought to be an intentional human individual (Latour, 1996) rooted in the Anglo-Saxon tradition. Most often misunderstood as mere behavior, the actor is the one that holds the power of act (Latour, 2005) or the one that is made to act by meaning no human intention from the ANT point of view. The main tenet of ANT is that actors themselves construct their own metaphysics frames, their own contexts, and their own ontologies (Latour, 2005). All the other entities also are actants, which are on the condition of being a source of the act. For ANT, actors live in a network system, which is a living, fluid organism. Network means a system of interconnected things. But from ANT's point of view, a network does not resemble sewage, a train, or a telephone line due to its connected, compulsory, and strategically organized nature (Latour, 1996). Because for ANT, there are no compulsory paths and strategically organized nodes (Latour, 1996). Everything happens to be in its relational network, in that particular time and space (Latour, 2014).

While offering a united nature with human and non-human entities, ANT also offers an ontological change of topological understanding, which is believed to be grounded on the geographical version of Cartesianism. Latour (1996) explains the network notion as an alternative topography to Deleuzian rhizomes or filaments. Nodes and networks, lines and dots, there is no classical space between the lines and nodes. They offer as many dimensions as they connect. By defining a new topology of actor-networks, it is not possible to talk about modern dichotomies such as subject-object, far-near, small scale-large scale, inside-outside, macro-micro distinctions or degrees of proximity. Two nodes are infinitely far away if they are not connected, and every node has the potential to be highly connected. The bigger network is also an intense form of the smaller ones. That is why the macro-micro scale is out of concern, which is also the end of the top-bottom relationship of social theories. In a world of relations between the nodes, there is just a void. The network is a boundary-like nature, and if it grows between the nodes, it is an expansion. Thus, there are also no outside-inside notions (Latour, 1996).

3. Actor-Network Theory and emerging concepts in architecture

The effects of the paradigm shift of science and technology studies have affected architectural studies after the 1960s. For science and technology studies, ANT suggests a new ontology to discover things' nature (Latour, 2014). Thus, the implication of architecture also suggests a material exploration of the built environment and the discovery of its materiality (Latour and Yaneva, 2008).

For Latour (2005, 2008a), phenomenology has also tried to change the paradigm that is a subject-oriented ontology. Husserl and Gibson's (1931) study on Cartesian thought emerged in the 20th century, but the effects of phenomenology on architecture have emerged in the late 20th century with Schulz (1965,1980), who injected human beings into the Cartesian system with his phenomenological studies. These studies seem to be a turn for architectural studies to eliminate the Cartesian system and find an alternative understanding of architecture. However, a decade later, phenomenology is also criticized for being a center of subjectivity (Zahavi, 2004; Latour and Yaneva, 2008). Latour and Yaneva (2008) also criticized phenomenology for misunderstanding the wholeness of the modern world due to the condition of being surrounded by subjectivity. Phenomenology frames the world around human beings and excludes non-humans and their materiality. That is why ANT tries to produce a way to understand the built environment regardless of being in the interest of human/non-human entities (Latour, 2005; Latour, and Yaneva, 2008). Thus, for discovering the true nature of things, one must follow traces, such as controversies, disputes, and traces of material things as a network, as an assemblage (Latour, 2005, Latour and Yaneva, 2008).

From the emergence of ANT (1986) to the implication of it to architectural studies (after 2005), there seem to be four major concepts that have been discussed. These concepts are the assemblage nature of architecture, architecture as mediator; architecture and translation; and architecture as a process of negotiation.

3.1. Architecture as relational network and an assemblage

Actor-Network Theory suggests looking at things as complex and fluid assemblages (Latour, 2014; Latour and Yaneva, 2008). The network system is described as a living network that gets bigger only by gathering more assemblages. Thus, there is no small/big distinction in ANT ontology. From brick to a city, everything is an assemblage that only differs by the scale of the components. From the architectural point of view, buildings are also complex assemblages that gather different agencies together. Edensor (2012), in his inquiry, has shown that buildings are constituted of small components that are continuously being "assembled" and "reassembled" based on continuously shifting stone supply chains, changing maintenance, and repair techniques (Hill, 2018). Materials are from various sources: wood, clay, tiles, plastic, glass, iron, and steel. These continually changing material nature make a building emergent and create a complex topology of relationalities across time and space, variously volatile and stable, enrolling materialities people and non-humans of different geographical and temporal scales (Edensor, 2012). Tracing small agents, Edensor (2012) reveals an assemblage of small agencies (biofilms and other life forms) and their transformative power of materiality of a building. Another approach to investigate the architectural relationality is Jones and Yarrow's (2013) analysis: The research shows how the different practices and tools of a diverse range of heterogeneous experts (curators, stonemasons, architects) give rise to different approaches to building conservation and notions of authenticity that are refracted through specific material contexts.

Conducted studies show architecture as an assemblage (as shown in Table 2) and demonstrate how architecture is an intertwined multiplicity of materiality (Guggenheim, 2009), and how the built environment is a complex topology (Edensor, 2012). Furthermore, framing architecture as an assemblage reveals how a building is a collaborative act between different users and tools (Schneider *et al*. 2010), how it helps to emerge different improvisions and interactions (Shilon and Shamir, 2016), and how it triggers immateriality, production of and multiplicity (Adam *et al.* 2014; Edensor, 2012; Stickells, 2011).

Table 2. Conducted studies on the intersection of ANT concept of "architecture as assemblage" and architectural field

Article	Topic	ANT Concept	Architectural Field
Edensor (2012)	The intertwined multiplicity of buildings material fabric	Architecture as Assemblage	Construction in Architecture
Shilon and Shamir (2016)	Variations and improvisations of Interactions as assemblages in airport	Architecture as Assemblage	User Behavior in Architecture
Schneider *et al.* (2010)	Design is a collaborative act between different users and tools	Architecture as Assemblage	Architectural Design
Adam *et al.* (2014)	Knowledge sharing as an assemblage process	Architecture as Assemblage	Architecture and Sociality
Jenkins (2002)	Building as a material and immaterial extension of nature	Architecture as Assemblage	Architecture and Environment Studies
Fallan (2008)	Discussing materiality, relationality and process of ANT	Architecture as Assemblage	Architecture and Materiality
Stickells (2011)	Erosion of certainties: The city is a complex assemblage	Architecture as Assemblage	Architectural Theory
Farias and Bender (2010)	The city is a complex assemblage.	Architecture as Assemblage	Architecture and Sociality

3.2. Architecture and translation

Modernity has set nature and culture as two separate ontological provinces; one is purification between species, the other is a translation (Latour, 2008). The translation is the process of carrying meaning between separated ontological fields. Since things are perceived as separate entities, the translation process becomes indispensable (Latour and Porter, 1993). Meaning, conflict, communication, and ideas are circulated steadily and never transferred seamlessly. "They are always in process, being interpreted in different indexical contexts, from different

positions of interest, making sense making inherently" (Naar and Clegg, 2018, p. 29). As mentioned before, translation refers to the processes of negotiation, representation, and displacement, which constitute new relations between things (Callon, 1986; Latour and Porter, 1993). In the architectural process, plenty of the network elements permanently re-negotiate, re-process with one another, reshaping the process, form, and revisable coalitions (Callon, 1986).

The problem of architecture is a problem of translation for Latour and Yaneva (2008). From the design process to the different stages of a building, there is always a translation process. The understanding of architecture as a historical artefact is also problematic (Latour and Yaneva, 2008). Latour and Yaneva (2008) think that perspective drawing, an invention of projective geometry, has been so deeply rooted in architecture that there is no helpful tool to understand the complex nature of the building. Although architecture is thought to be a language of representation (Vesely, 2004), plans, sections, elevations, and models always need a translator, such as an architect, to translate them into daily language.

On the contrary, as presented in the social process, architecture, ideas, and design processes never circulate smoothly. That is why buildings and human beings cannot meet at the same time and space. The problem of translation (Star and Griesemer, 1989) is one of the central problems in architectural production.

Thus, in different stages of a building, a "translator" needs to speak on behalf of others, involving a set of negotiations, calculations, persuasions, and other relations to navigate the authority and power (Callon and Latour, 1981). To give an illustration for architectural design, one must enroll people from various stakeholders, put into practice clients' concerns with the office's programmatic goals. That is why the architect becomes a gatekeeper (Star and Griesemer, 1989), always in center stage (Latour, 2005).

However, every translation is also a form of rewriting (Lefevere, 2016), and every mediation process is a form of unforeseen relationalities (Latour, 2005). Studying design discipline in OMA, one of the most well-known offices, Yaneva's (2009a) inquiring reveals that architectural design has its translation process. The problem of architectural design is the perception of it as a sequential work that starts with the sketch of the star architect. However, on the contrary to this common belief, Yaneva (2009a) explores that in OMA, design activity is not founded on a sketch but on the blue foam. The usage of blue foam with different scales and different details at the same time helps designers to see different problems at the same time. Models seem to mean nothing at first sight: but, they get attributes and "achieve their form" as an outcome of social and technical relations (Law, 1992, 1994, 1999). Sharif (2019), with his study about Whitworth Art Gallery in Manchester, investigates how each user translates his/her own script rather than the expected scenarios of design. As a result, each individual turns out to be a potential writer of his/her own way to experience the museum.

The ethnographic translation process of architecture on different stages of architectural practice, such as design, construction, and usage, helps to understand complex rationalities of the materiality of a building (as shown in Table 3). Furthermore, the translation process reveals how different actors mediate the actions and the actual nature of that action further from canonic beliefs or preconceptions.

Table 3. Conducted studies on the intersection of the ANT concept of "architecture and translation" and the architectural field

Article	Topic	ANT Concept	Architectural Field
Sharif (2019)	Diverse interpretations and reactions of users as multiple universes of translation	Architecture and Translation	User Behavior in Architecture
Naar and Clegg (2018)	Model usage in Gehry's design in action	Architecture and Translation	Architectural Design

3.3. Architecture as a mediator

The architectural application of ANT focuses on the material nature of things and how they trigger action. Ethnographic studies, such as the design nature at OMA (Yaneva, 2009a) or Gehry's

architectural office (Naar and Clegg, 2018), have proved that architectural design practice in fact, has different translation processes. Furthermore, for Latour (2005), translation is a process, and through that process, things are transformed by translators according to the type of translation. There are two types of translation. First is an intermediary type of translation, which means defining its inputs is enough to define the outputs; there is no transformation of meaning. This type of translation can be perceived as a black box (Latour, 2005). The second one is the mediators that transform the meaning while carrying it. Thus, inputs and outputs are never equal to each other; each time, the existence of a translator must be taken into consideration because mediators transform, translate and deform the meaning (Latour, 2005). "A properly functioning computer could be taken as a complicated intermediary, while a conversation may become a complex chain of mediators, where options, choices bifurcate in every possible sequence" (Latour, 2005, p. 39).

Architecture is a series of connected spaces. The building is an actor that navigates users to move in a particular direction while at the same time giving a series of choices (Hetherington, 1997; Yaneva, 2005). Corridors, doors open to specific directions, lifts, and stairs connect certain points in space that are arranged so that certain types of activities can be conducted (Murdoch, 1998; Yaneva, 2005). However, it is commonly perceived that buildings are static beings. On the contrary, once built, it is transformed through time, modified by what happened inside or outside (Latour and Yaneva, 2008). That power of making things act in different ways also makes architecture a mediator. Therefore, the most crucial problem discussed today is the Euclidian space, commonly signified as the reason for the static view of the buildings. CAD renderings, unrealistic photographic works cover the true nature of buildings so that it is nearly impossible to grasp them as a plural ecology that unites city constraints, budget options, continuous demands, neighbors, and communities (Latour, 2008). To be able to grasp the architecture in true ecology, one must look at its material reality. Due to that need, different studies reveal how a building navigates its environment or its design process or construction in terms of ANT. Not just the building itself, but the other components of a building can become a mediator. Conducting an experimental study on the renovation of Alte Aula, Yaneva (2008) reveals that a new actor (the frescoes) has emerged that has led other new actors to move, and reshape the process of renovation. In Norrebro Park in Copenhagen, another study reveals an invisible actor that has joined the design process and mediated it. Hill (2018) explores that notions, such as renovation and restoration, also mediates the decision-making mechanisms. Exploring the polluted earth makes designers re-think the design (Moller, 2018). It is even possible to see how the law is also an essential factor that shapes the construction. In a comparative research on a mosque-church construction dispute, material and social aspects of the situation determined the building type and construction of it. Discussing the politics around the minaret and its function, Guggenheim (2010) reveals that function is also mediated by the politics. Architecture is also mediated by different laws and beliefs or public opinions that shape the built environment (Guggenheim, 2010). A different study about a park. Superkilen. a park in Copenhagen, compares discourses of Superkilen's architects who planned for the park to be a cultural encounter with a part of daily practice. As a result, the programming of Superkilen turned out to be a failure to create interactions, due to the lack of considering the cultural preferences of multi-ethnic communities (Daly, 2020). Thus, the spatial representation of space precedes its practice.

On the other side, some inquiries show that each process has its unique sociality that an actor can be a translator and also can mediate the process for construction or design. In his study about Paimio Sanatorium, Heikinheimo (2018) declares that Aalto had become a translator for describing the project to different interest groups in different ways and therefore had mediated the process of design in terms of unexpected problems. Other than the material approaches, in his inquiry of emotional geographies, Lees and Baxter (2011) investigate the emotion of fear in high-rise building blocks. By following traces of fear, deploying ANT has revealed the fact that fear becomes one of the important actors of experiencing high-rise buildings and conclude that the architectural designers and geographers should take the human subjectivity into their analyses of lived experiences of the built environment, also, argument that emotional geographies should be taken into consideration more in the built environment.

The framework of mediation helps hidden actors involved in action become visible other than as presuppositions (Table 4). Also, it reveals how so-called solid facts as functions, such as church or minaret, mediates the politics, how unseen actors such as frescoes can redefine the process of construction, how doctrines can mediate decision-making mechanisms. Mediation also shows how every actor involved in a process becomes intertwined with each other, and in the end, the thing that has the power of act mediates the action.

Table 4. Conducted studies on the intersection of the ANT concept of "architecture as mediator" and architectural field

Article	Topic	ANT Concept	Architectural Field
Yaneva (2005)	Scale as a mediator of the design process	Architecture as Mediator	Architectural Design
Yaneva (2008)	Alte Aula as a mediator of the renovation process	Architecture as Mediator	Architecture and Materiality
Moller (2018)	The mediation of unforeseen actors of the design process of Norrebo Park	Architecture as Mediator	Architecture and Materiality
Yaneva (2009b)	Design mediates shapes, conditions, and facilities of the university building	Architecture as Mediator	Architecture and Sociality
Daly (2020)	Distribution of actions by Superkilen Park design	Architecture as Mediator	Architecture and Sociality
Hill (2018)	How the notion of heritage mediates the renovation process	Architecture as Mediator	Renovation, Restoration
Guggenheim (2010)	Building types as mediation for intervention	Architecture as Mediator	Architecture and Sociality
Damon (2011)	Legal constraints mediate the emergence of new spaces in architecture	Architecture as Mediator	Architecture and Sociality
Guggenheim (2010)	Zoning laws mediate the building types and usages	Architecture as Mediator	Architecture and Sociality
Beauregard (2015)	Delegation of responsibility to non-humans	Architecture as Mediator	Architecture and Materiality
Lees and Baxter (2011)	The feeling of fear mediates the experience of a high-rise building.	Architecture as Mediator	Architectural Experience
Peltonen (2011)	Finnish University as a mediator of social interactions	Architecture as Mediator	Architecture and Sociality
Brien and Psarra (2015)	Spatial configurations as a mediator of space, society and meaning	Architecture as Mediator	Architecture and Sociality
Ruiz and Strickfaden (2016)	Architecture as a mediator of embedded experiences of blind people	Architecture as Mediator	Architectural Experience
Leuenberger (2015)	The power of architecture mediates architectonic experiences	Architecture as Mediator	Architectural Experience

3.4. Architecture as a process of negotiation

Actor-Network Theory reveals how the process of science is constructed upon the negotiation (Law, 1986). Just as laboratory facts, architectural design is also a negotiation process between the clients, designers, and various stakeholders (Star and Griesemer, 1989). An architect has to represent and translate the language of design to various people, the expectations of clients, the vision of the architect, the design process of the office, and compulsory situations that context brings, along with regulations and various other elements. Many researchers have tried to explore how models are used in assembling and stabilizing multifarious human and non-human entities (actors) in the socio-material world of a design project (Alcadipani and Hassard, 2010; Latour and Yaneva, 2008; Law, 1999, 2008a). After the ethnographic process in OMA, Yaneva (2009a) discovers that usage of blue foam as a dominant factor that has effects on various parts of the design and the design itself is a result of the negotiation of many stakeholders. Following another

controversy about the design of a Danish telephone box, it is also discovered that design is a result of negotiation. However, these negotiation processes are shaped by not only the positive actions of actors but also negative ones (Abildgaard, 2019).

The negotiation and usage of various mediators in this process is one of the inherent qualities of architectural practice. Each design is expected to be unique due to the tabula rasa mindset of creativeness (Oosterling, 2009), albeit with familiar resemblances. Clients are aware of other designs of a particular firm but cannot expect similar results due to the expected uniqueness of design. Thus, every design entails high collaboration with various agencies, organizations and stakeholders. Each process requires a new assemblage of many actors (Bechky, 2006; Miettinen, *et al.* 2009). Not only design process but also there are some cases that even their being has become a part of power politics. In his study, Beauregard (2015) investigates the controversy that has arisen around the American Folk-Art Museum's demolition in New York and argues that the notion of conservation is also a negotiation. In 2014, the American Folk-Art Museum lived financial difficulties and was sold to one of the most famous contemporary museums, MOMA. Designed by Tod Williams-Billie Tsien Architects' well-known firm, the American Folk-Art Museum building is considered a contemporary heritage of the country. Despite the architectural community's objections, MOMA declared that, based on the recommendations of another well-known firm, Diller Scofidio & Renfro, the building needed to be demolished. From Beauregard's (2015) point of view, this process has taken its shape around power politics, which MOMA brought to the forefront. As a result, the building was demolished despite the objections. Beauregard (2015) interprets that process as Foucauldian power politics (Foucault, 2016). Schmidt *et al.* (2012) examine how micropolitics and macropolitics shape the building's design in terms of greater understanding and reconceptualization of the underlying forces behind the design process. Doing ethnographic research at the architectural office, they have compared two separate design processes and influences of actors involved. The research reveals that big politics is always shaped by micropolitics, and they are both relational. Both human and non-human actors and their power to move is capable of changing every political codification.

Table 5. Conducted studies on the intersection of the ANT concept of "process of negotiation" and architectural field

Article	Topic	ANT Concept	Architectural Field
Schmidt *et al.* (2012)	Politics of design mediates the building's capacity to adapt	Architecture as a Process of Negotiation	Architectural Design
Karrholm (2013)	Building types as a collective negotiation	Architecture as a Process of Negotiation	Architectural Theory
Azizkhani (2015)	The notion of function as a historically constructed reconciliation	Architecture as a Process of Negotiation	Architectural Theory
Heikinheimo (2018)	Collaborative design of Paimio Sanatorium	Architecture as a Process of Negotiation	Architectural Design
Tait and While (2009)	The notion of heritage as a historically constructed reconciliation	Architecture as a Process of Negotiation	Architectural History
Chugh and Hancock (2009)	Construction of a network of aestheticization	Architecture as a Process of Negotiation	Architectural Theory
Chambon (2007)	Architectural style as a reconciliation	Architecture as a Process of Negotiation	Architectural Theory

Negotiation can be one of the revolutionist frames derived from ANT to architecture because it reveals how common facts are constructed between different groups and stakeholders.

Furthermore, it reveals how power relations shape the common beliefs of facts about architectural practice. On the contrary, fewer studies seem to have been conducted on the topic of negotiation (Table 5).

When looked at all the studies and their relations to architectural field, it is also possible to see new relations as shown in the Figure 1. Most studied area in the intersection is “architecture as mediator” category which is also related to experience, sociality, design, materiality and restoration categories (Figure 1). Negotiation and assemblage categories relatively week, and translation, time and space, topology is less studied fields in terms or architecture.

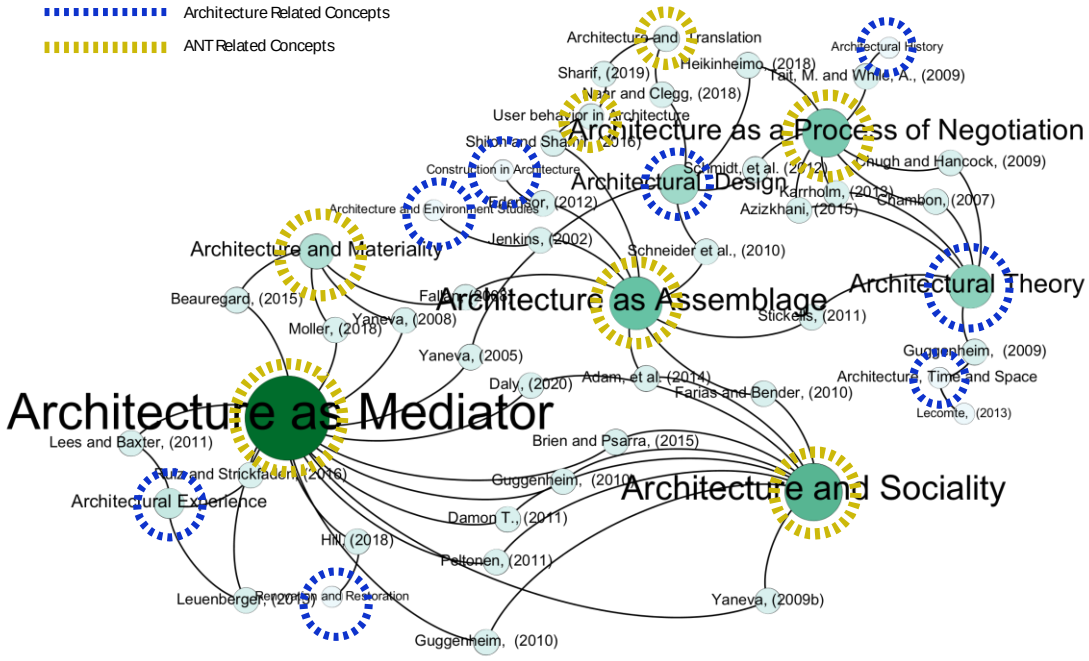

Figure 1. Superposition of conducted studies in the intersection of ANT and architecture

Conducted studies are listed separately in each section as Tables 1, 2, 3, 4, 5, 6 on the emerging concepts deriving from ANT and “Architectural Concepts.” Figure 1 has been generated using Gephi and relations rendered with the Degree Range engine. Gephi gives color according to their relationality range in the whole network. Dark green is the most relational one (most studied field/notion), while the light one is less related (least studied field/notion) in the whole network. The bigger nodes show the most related categories, while the smaller ones are less related in the whole network. The network shows most-leart studied fields and notions on the intersection of ANT and architecture.

Table 6. Developing concepts on the intersection of the ANT concept and architectural field

Article	Topic	ANT Concept	Architectural Field
Guggenheim, (2009)	How buildings stabilize time and memory	Architecture, Time and Space	Architectural Theory
Lecomte, (2013)	Topological understanding and dualisms	Architecture, Time and Space	Architectural Theory

4. Conclusion

Analyzing the studies of ANT in architectural discipline, new perspectives seem to have emerged. The most important contribution of ANT studies is that it has proved that canonized discourse differs from fact. Just like scientific studies, architectural knowledge is also constructed upon limited and predetermined aspects of architecture. Design is thought to be a master architect's work. The building is thought to be a composition of planes and columns. All the processes in architectural production seem to be perceived as separate from each other. ANT studies have revealed how all these processes are intertwined and how a complex network emerges from a single production. As a result, ANT becomes a helpful tool to reveal architecture's relationality and materiality.

4.1. ANT and architectural studies

At the threshold of ANT and architectural studies, mediation, translation, assemblage, and negotiation are prominent emerging conceptual frameworks derived from ANT. "Construction in Architecture," "User Behavior in Architecture," "Architectural Design," Architecture and Sociality", "Architecture and Environment," "Architecture and Materiality," "Architectural Theory," "Renovation, Restoration," "Architectural Experience," and "Architectural History" were the main themes of the conducted studies on the architectural basis. The studies of intersection have been gathered under the theme of "mediation." "Translation" and "Negotiation" are relatively new developing fields (as seen in Figure 1). The second most related ANT concepts are "Negotiation" and "Assemblage," as shown in Table 6 and Figure 1. Most related architectural concepts are "Architectural Theory," "Architectural Design," and "Architecture and Sociality," as shown in Table 6 and Figure 1. Experimental studies, such as how buildings stabilize memory, topology, or theoretical studies defining the buildings as technological artefacts, need further studies (Table 5).

Due to the novel nature of ANT, its implications in the field of architecture date back to 2005. As seen in Table 6, most of the studies about architecture and ANT relate to the "mediator" category (as seen in Part 3.3 and Table 3), which follows the traces of different actors mediating the nature of the built environment from many different perspectives. For architectural concepts, mediation relates primarily to "Architectural Design," "Architecture and Sociality," and "Architectural Theory." For expanding the view, further investigations must be conducted. The "Translation" field, on the other hand, reveals how different actors come to the forefront in different phases of a building. "Translation" refers to an actor who becomes a gatekeeper for different translation processes. Thus, it unveils a form of navigating the meaning on behalf of the building. Furthermore, translation may be a way to show the plural nature of the experience of an architectural entity and how different non-humans enroll in the process as an implicit actor. On the contrary, translation is the most undeveloped category as it has only one relation to just the design category. Translation needs further investigations to expand in the field of architecture. In addition to these, ANT also seems to offer an understanding of the plural nature of architecture and design, such as clients, designers, and neighbors, while at the same time understanding the multiplicity of the built environment. This stage, called the "Process of Negotiation," refers to the sociality that emerges from a material entity. According to ANT's perspective of architectural studies, design processes, renovations, and other production stages are multiple universes that reveal plurality. The most major contribution of the negotiation process is that it displaces the classic understanding of subject-oriented thinking and reveals other actors who are participating in a case regardless of being human or non-human. Negotiation studies are mostly related to "Architectural Theory" and "Design." For expanding the field, further studies are needed. Moreover, the studies under the title of "Assemblage" trace the network systems from the minor heterogeneous actors to major ones. Framing it with the architectural field, from a single stone to the building, from a single door to planning, elevation, and the whole architectural environment, a significant habitat emerges, revealing how the architectural environment is limited in current studies. A building is a world of heterogeneous beings that has its unique habitus. Every actor has a greater or lesser impact on that habitus. The assemblage category is most related to

"Architecture and Materiality," "Architecture and Sociality," "Architecture and Design," and "Architectural Theory." For expanding the field, further studies must be conducted.

4.2. ANT and architectural relationality

Notions and concepts that emerged in architecture deriving from ANT vocabulary seem to have the potential to drive forward the implicit material reality and agency of the architectural environment, including heterogeneity and complexity of actors and networks. Furthermore, the theory helps the researchers understand that there is no straightforward content, no routine, and no prototype of design acting, designed things' environment, and their agency. To be able to understand the whole nature of things, one must look at experiences, users, designers, and the rest of the actors involved in that particular nature of the architectural environment at a specific time and space from the heterogeneous and relational point of view. Architects work with a complex and plural nature and can understand buildings' complex meanings and the plurality of actions. More studies need to be conducted in these areas.

Furthermore, one of the most important contributions of ANT to architecture seems to bring new definitions to canonized concepts and situations by displacing established beliefs in design, architecture, and their power to socialize. Even ANT suggests understanding complex network systems when looking at the studies and their relationality to architectural fields (as seen in Figure 1). There is a considerable research gap analyzing and thinking about building processes' complex nature relating to design, usage, and construction processes. Thus, further studies have to be conducted to get a multiple and entangled nature of a building that is affecting, stimulating ideas, actions, and discourses. ANT and architecture already seem to expand to the various architecture fields and are promising for new perspectives.

4.3. Challenges and objections

The most controversial side of ANT is that ANT researchers need to speak on behalf of non-human things (Fallan, 2008). Law (2008a) indicates that the problem for this misunderstanding is the human-centric mindset. One must understand that ANT is a practical tool for understanding actors' actions and their effects on other actors. Thus, action and effect are significant signifiers of ANT, but the problem is that there are many other actors in a case that probably do not cause that effect. This is an important distinction for a theory offering a symmetrical view to disregard the actors who do not have the power of effect.

To trace networks, ANT offers an opportunity to look at material entities and controversies (Law, 2008a). Karrholm (2013) also criticized Latour's (2008) preoccupation with controversies as the location of dynamics and suggested that ANT could be a beneficial perspective to study the ordinary (Fallan, 2008; Heikinheimo, 2018). Since there is no distinction between human and non-human, ANT helps to understand how social is constructed upon the material, how material navigates the social, how gatekeepers can mediate the understanding of the built environment with different groups of interests, and how different stakeholders shape the building from the start to the construction process. The most valuable accomplishment of ANT for architecture seems to start the thinking of the building as an actor. In the framework of this study, there seem to be two gaps emerging. The first one is that ANT helps to understand the complex, controversial, conflicted nature of buildings and how they produce social in different concepts. There have been no further studies on superposing plurality and the intertwined nature of a building. The second gap is the basic tenet of ANT which is the actor-actant construction. Claiming to overcome asymmetries of the modern world, ANT may seem to construct one on the act of power by defining "actor and actant," where one has the power of action and the other disregards entities with no effects on one particular event. Further studies are needed to understand the effects of ANT on architecture and design.

Future research directions continue to expand architectural notions in the intersection of ANT and explore architecture's material conditions. Analyzing the boundaries of ANT may help architecture to understand and explore the plurality (human-nonhuman entities) and entangled nature of architecture (as a network system) in terms of matter and meaning.

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