Techno-Government Networks: Actor-Network Theory in Electronic Government Research

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General E-Government Track

Abstract. *The Actor-Network Theory (ANT) is a theoretical approach for the study of controversies associated with scientific discoveries and technological innovations through the networks of actors involved in such actions. This approach has generated studies in Information Systems (IS) since 1990, however few studies have examined the use of this approach in the e-government area. Thus, this paper aims to broaden the theoretical approaches on e-government, by presenting ANT as a theoretical framework for e-government studies via published empirical work. For this reason, the historical background of ANT is described, duly listing its theoretical and methodological premises. In addition to this, one presented ANT-based e-government works, in order to illustrate how ANT can be applied in empirical studies in this knowledge area.*

Keywords: Electronic Government; Methodology; Actor-Network Theory.

1   Introduction

Studies in e-government have expanded and investigated the nuances of Information and Communication Technology (ICT) projects in government. Although the relevance of e-government has been confirmed in recent years through the growing academic and professional interest in this field, authors question the theoretical fragility of this area [1]. Thus, academics have defended broadening e-government theoretical frameworks, where there is "little use of frameworks of knowledge from governance," "dominance of positivist research approaches, alongside absence of statements on research philosophy," a "dominance of a-theoretical approaches that, simultaneously, often fail to provide any significant practical recommendations" [1, p 260]. To a certain extent, these questions also arise within the IS community in general, where there is a demand for studies geared at looking beyond the efficiency of ICT in organizations [2-5].

Bearing in mind the importance of broadening the e-government theoretical framework, this theoretical essay seeks to strengthen the theoretical side of this knowledge area, by presenting the Actor-Network Theory (ANT) as a viable approach to the study of government ICT projects.

ANT consists of a theoretical and methodological framework for the study of scientific discoveries and technological innovation. As such, it encompasses different heterogeneous actors involved in scientific activities, from researchers and their equipment, to politicians, investors and social movements which are, in some way, related to technological undertakings [6].

As has occurred in other areas, ANT has been used in Information Systems research since the 1990s [7, 8] and with greater intensity since 2000 [9]. Studies based on ANT have also been undertaken on topics related to e-government[10, 11], such as tax systems [12-14], intellectual property [15], IT public policy [16], e-health [17, 18], and digital inclusion [19-21]. ANT is consequently considered to be a relevant theoretical approach to use for IS studies [7, 9, 22], as well as for e-government. This paper therefore aims to analyze how ANT has inspired studies in the e-government area, so as to better understand the possibilities of conducting ANT-based research in this realm.

For this, a bibliographic review was undertaken on ANT-based studies in the area of e-government, seeking to evaluate: a) how the ANT-based approach has developed over the last thirty years; b) the theoretical and methodological concepts proposed by the ANT approach, and c) the way ANT-based research has contributed towards a better understanding of the socio-technical phenomena associated with e-government ventures. Finally, a discussion is presented regarding the limitations of this research approach, as well as the possibility of using other ANT-based concepts in research into e-government.

2. Actor-Network Theory (ANT)

2.1 ANT Background

The Actor-Network Theory emerged in the late 1970s in the context of Science and Technology Studies (STS), when Michel Callon [23] and Bruno Latour [6] presented their preliminary concepts of ANT. This approach began to take shape in the early 1980s, when Callon and Latour [24] made use of the inscription and black boxes concepts to describe associations between heterogeneous actors. Such associations can be preceded by infighting and conflict but, once established, can conceal dissonant voices and become black boxes. These black boxes "contain that which no longer needs to be reconsidered, those things whose contents have become a matter of indifference." [24, p. 285]. Thus, Callon and Latour [24] argued that successive black boxes form the so-called social structure, challenging the existence of an underlying strength that governs society, ascribing that strength to the own history of men and artifacts.

A few years later, while studying the work of scientists involved in scallop farming in the south of France, Callon [4] explained the negotiation and consensus process between the different actors involved in that research, including scientists, fishermen, and the scallops per se. That work presented the concepts of translation, obligatory passage point (OPP) and generalized symmetry.

The translation widely used in ANT studies can be understood as the mobilization of actors around a common objective [4], called an obligatory passage point (OPP), which establishes the link between the network of actors [4].

In his study about the scallop researchers, Callon observed that the three researchers established an OPP and created identities for the fishermen, the scallops and the scientific community, thereby becoming the spokesman for these groups. Fig. 1 shows examples of the OPP established – the scientists' research program – for which the different case actors altered their preferences.
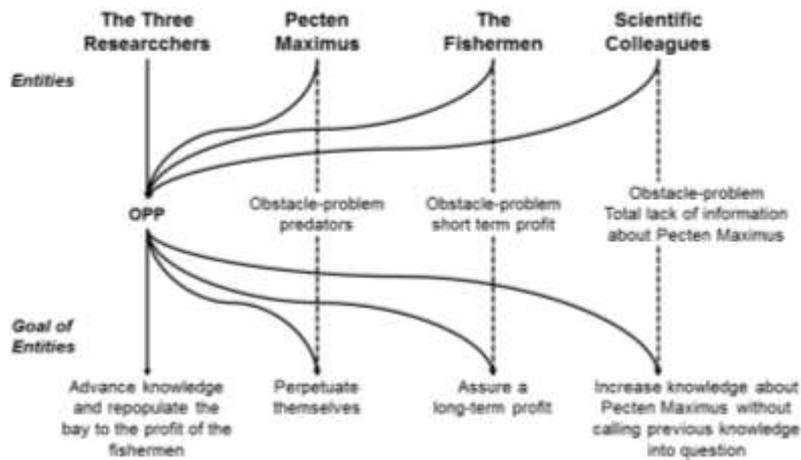

Fig. 1. Establishing an obligatory passage point. Source: Callon [4].

The translation is operationalized in four moments: problematization, interessement, enrollment, and mobilization. That is to say, the translation moments "are discerned in the attempts by these researchers to impose themselves and their definition of the situation on others" [4, p. 196]. Problematization involves identifying the actors and the OPP to which the actors should converge. Interessement is the stage involving the mapping of the identities, preferences and alliances of the actors and their possible relationships with the OPP. Enrollment involves the negotiations to alter the preferences of the actors towards the OPP. Finally, mobilization encompasses the actions of the actors to ensure that the objective is attained.

Furthermore, Callon explores the concept of generalized symmetry, since the same vocabulary is used to analyze negotiations with the natural and social world, so as "not to change registers when we move from the technical to the social aspects of the problem studied" [4, p. 199]. In other words, all actors are analyzed in the same way, without

separating nature from society, or the technician from the lay person. Thus, the author argues that it is not possible to separate the technical from the social, and that these two categories should be analyzed within the same plan and by using a symmetrical approach.

2.2   Technoscience in Action

In 1987, Bruno Latour [6] published his book Science in Action, in which he presented the principles and methodological procedures of ANT-based research. Latour therefore proposed a methodological framework for the study of scientific discoveries and technological innovation.

Latour put forward a technoscience concept that involves "all the elements tied to scientific content, no matter how dirty, unexpected or strange they may appear" [6, p. 286]. That is to say, technoscience seeks to include all heterogeneous actors involved in scientific activities, from researchers and their equipment, to politicians, investors and society who are, in some way, related to scientific ventures. This is based on the six principles and seven methodological rules derived, as shown in Table 1.

Table 1. Methodological principles and rules for the study of Techno-science. Source: Latour [6].

Principles	Methodological Rules
I. A scientific fact or a technological innovation is "what is collectively stabilized from the midst of controversies, when the activity […] does not consist only of criticism or deformation but also of confirmation" (p.42).	I. Study the technoscience under construction.
II. Scientists and engineers "speak in the name of new allies that they have shaped and enrolled; representatives among other representatives, they add these unexpected resources to tip the balance of force in their favor." (p. 90).	II. "the fate of facts and machines is in the hands of later users" (p. 59)
III. "We are never confronted with science, technology and society, but with a gamut of weaker and stronger associations; thus, understanding what facts and machines are, is the same task as understanding who the people are" (p. 140-141).	III. "We can never use the outcome-Nature- to explain how and why a controversy has been settled" (p. 99).
	IV. "We cannot use society to explain how and why a controversy has been settled." (p. 258).
IV. "science and technology' is only a subset of technoscience" (p. 259)	V. "every time an inside/outside divide is built, we should study the two sides simultaneously and make the list, no matter how long and heterogeneous, of those who do the work" (p. 176).

| V. No separation exists between scientists and lay persons. | VI. Consider the other person's point of view. |
| VI. Major scientific discoveries & technological innovations are merely a succession of events. | VII. Analyze the network to understand the behavior. |

The six principles presented in Table 1 form the ontology of ANT, whereas the seven methodological rules shown in Table 1 guide the work of a researcher who seeks to reconstruct the actor-networks that represent scientific discoveries and innovations. Thus, it may be observed that there are no differences between science, technology and society. That is to say, all of these are interlinked within the same world via actor-networks, which can consist of both humans as well as technical artifacts.

ANT does not assume the free will of individuals, nor the possibility of underlying structures that govern social relationships. As a counterpoint, it is based on the assumption that relationships between human beings are governed by long chains of actor-networks which have been inscribed by successive translation processes.

Finally, the work of scientists and engineers is not to make discoveries, but to enroll allies and establish actor-networks, which are inscribed by means of technical artifacts and scientific facts. Several studies have thus been developed based on these assumptions.

One of these studies, which is often cited in the area of e-government, is the research undertaken by Law and Callon [25] on the trajectory of a project to construct military aircraft in England. That study expanded the analysis of networks and actors by observing that: "the success and shape of a project, the TSR.2, depended crucially on the creation of two networks and on the exchange of intermediaries between these networks." [25, p. 41]. That is to say, it can be seen that, in addition to emphasizing only one local network, as elaborated by Callon [4] in his study on scallops, Law and Callon [25] study the interaction between two networks of actors, broadening their analysis to include, not only the technicians, but also the project sponsors.

Law and Callon [25] represented the trajectory of the TSR.2 project by means of a bi-dimensional chart (Fig. 2), "where x axis measures the degree of mobilization of local actors," and the "y axis measures the extent to which external actors are linked" [25, p. 47]. A project where the global network is highly cohesive and the local network is highly mobilized, that is to say, one that is placed in the top right hand quadrant, is a solid, indispensable project; the opposite, placed in the lower right hand quadrant, is a very weak and disaggregated project. This is how the different stages of the project were designed in the chart, indicating the degree of cohesion of the global network and the mobilization of the local network.

Another pertinent study was carried out by Akrich [26], who analyzed social technological projects developed in France and used in countries in Africa. According to Akrich [26, p. 208]: "A large part of the work of innovators is that of 'inscribing' this vision of (or prediction about) the world in the technical content of the new object. I will call the end product of this work a 'script' or a 'scenarium.'" Thus, technologies "represented a large

set of technically delegated prescriptions addressed by the innovator to the user." [26, p. 211].

Akrich [26, pp. 208-209] states that: "we have to go back and forth continually between the designer and the user, between the designer's projected user and the real user, between the world inscribed in the object and the world described by its displacement." That is to say, Akrich defends an investigation of the controversies that exist between functions inscribed in technical artifacts and their use in the real environment. This concept has been widely used in IS research, where information systems inscribe specific visions and, when deployed, go through a series of negotiations with the users.
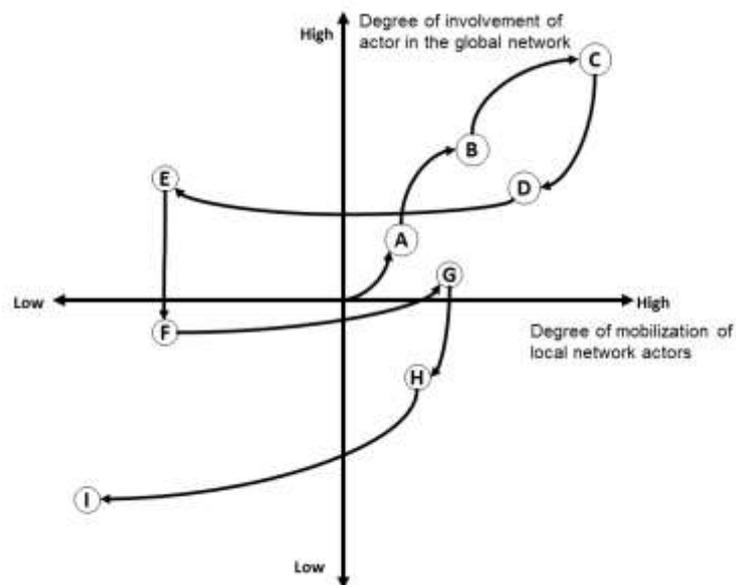

Fig. 2. Chart showing the trajectory of the TSR.2 project. Source: Law and Callon [26].

2.3   ANT Advances and Revisions

Later in the 1980s, John Law joined forces with Callon and Latour and this group began to foment an ANT-based research agenda. After this period of conceptual development, a debate began about the ANT approach in sociology in general [22]. It is worth remembering that studies undertaken in the decade between 1980 and 1990 were limited to the discussion of scientific discoveries. From 1990 onwards, ANT researchers began to defend this theory in a much broader and more complex space, such as economic sociology and political economy.

In 1999, Law and Hassard [5] edited a book called "Actor Network Theory and After," which resulted from a seminar with the main researchers engaged with ANT, to assess the

implications of this approach up to that time. Over the following years, ANT-based research multiplied on various fronts, especially in the areas of communications [27], environment [28], economic sociology [29], and heterogeneous methods [30]. It is worth stressing that, in 2006, Bruno Latour [3], presented a review of ANT. That research work redeems the main concepts of ANT, providing a guide for social research based on this approach.

The concepts revised by Latour [3] were strongly influenced by the book Science in Action, published in 1987 [6] and presented in section 2.2. The difference between these two is that, while Latour's work is limited to scientists and engineers [6], the most recent publication presents an outline for general social science research [3]. The recent work does not go into a lengthy discussion about such concepts, though the reader can obtain more in-depth information by studying the original work [3].

Thus, the theoretical and methodological approaches developed within the scope of ANT can be useful to understand e-government projects. The main concepts related to these approaches are summarized in Table 2.

The following section therefore discusses how ANT has served to inspire studies in e-government.

Table 2. Actor-Network Theory concepts. Source: constructed by the authors.

CONCEPT	DEFINITION
Fact establishment	Truth is not something external waiting to be caught but rather a collective construction associated with several translations [6].
Translation	"To translate is to displace […] to translate is also to express in one's own language what others say and want, why they act in the way they do and how they associate with each other: it is to establish oneself as a spokesman" [4, pp. 213-214].
Symmetry	"not to change registers when we move from the technical to the social aspects of the problem studied" [4, p. 199].
Obligatory passage point	A point where the actors change their preferences in order to overcome barriers so as to achieve their initial objectives [4].
Actor-network	Association of heterogeneous elements with a structure, which is susceptible to change [4, 6, 25].
Inscription	Visions of the world are inscribed in the technical content of objects [31].

3 Actor-Network Theory and Electronic Government Research

As mentioned in the introduction, Actor-Network Theory has served to inspire research into information systems since 1990. In relation to the area of e-government, such research has involved e-procurement [12], tax systems [13, 14, 32], the judicial system [33, 34], intellectual property [15], IT public policy [16], geo-processing [35, 36], e-health [17, 18, 37], e-governance [11, 38] and digital inclusion [19-21]. Some of the theoretical and

methodological concepts outlined in this approach can be useful to understand e-government undertakings. In this respect, some of these elements may be highlighted.

Moments of translation [4] have been widely used in e-government research [13, 19, 21]. In these processes, systems of e-government are understood to be similar to an OPP, where the other actors tend to converge during the course of the translation. In this way, research seeks to understand how e-government projects involve a heterogeneous network of actors, since their success is closely linked to the occurrence of translations. This means that the purpose is not to find factors of success associated with the system, but to understand why e-government projects are a collective construction, in which different actors altered their preferences around an e-government system, by means of successive translations.

Furthermore, in ANT-inspired studies on e-government, a longitudinal approach is often observed [10, 13, 15, 19, 21], the aim of such research being to study the movement, formation of groups and translations, rather than collecting information about a specific moment.

The study related to the TSR.2 aircraft [25] has also become a benchmark in ANT-based e-government studies, which sought to understand the trajectory of projects by means of analyses based on global and local networks [13, 16, 19]. In several cases, the research transcends the formal dimensions of an organization. The empirical freedom of ANT enables researchers to understand the relationship that exists between politicians, technicians and professionals [17], between governments and international organs [13, 32] or, indeed, between citizens and social movements [39]. This complex scenario was revealed, for example, in the study into the computerization of the Brazilian judicial system, which investigated the country's courts of justice [33] and the cooperation between patent offices for the transfer of technology [15]. Analysis of the cases in a symmetric manner took into consideration the whole spectrum of actors involved in e-government projects. Thus, in addition to the professionals involved, it also included other actors – such as politicians, citizens, social movements, etc.

In this way, the studies analyzed complex environments involving multiple actors who often have markedly divergent preferences. By means of the translation concept, ANT provides a theoretical tool to analyze the points of convergence of these preferences and the studies are therefore able to illustrate the political dimensions involved in installing an e-government system. On this point, ANT-based studies reinforce the entreaties of the scientific community, who defend the importance of changing the focus from tools to management of IS projects in organizations, while also bearing in mind the economic, political and negotiation aspects of such systems [2].

Moreover, in ANT research, there is an age-old tradition of using graphs to explain phenomena. For this reason, several studies use them to unveil the dynamics of heterogeneous networks associated with IS and e-government development and implementation. [11, 13, 16, 35, 38-45]. Thus, ANT can also be used to depict the research context under analysis.

The flexibility shown by researchers in their approach to the field of e-government may also be observed. In accordance with ANT premises, micro or macro actors, simple or complex contexts, are not differentiated a priori, since such definitions are obtained during the empirical analysis. The proposal outlined by Latour [3], which is to follow the actors themselves, has contributed to revealing the issues that emerge from the actors themselves, rather than seeking responses based on pre-defined models. For instance, situations peculiar to developing countries, such as telecenters [20, 21], can provide a relevant contribution to the academic debate about e-government.

4   Discussion and Final Considerations

This theoretical essay reviewed the scientific literature to identify how the ANT approach has been used in e-government studies. Based on the historical trajectory in relation to ANT, it may be seen that an approach such as this, which began with studies in technological science, also came to discuss sociological and political issues in general. By and large, the empirical nature of ANT can contribute to the development of research directions that can take into consideration the nuances of e-government projects. That is to say, instead of starting with a pre-existing model from another area, researchers can dedicate themselves to understanding a practical situation and deliberate over this.

The proposal to avoid using previously-established theories has led to a certain amount of criticism about the essentially descriptive character of ANT; that is to say, ANT-based studies run the risk of becoming mere case descriptions [7, 9], without having to provide any explanations or indicators for social change. Latour [3] responded to these criticisms by suggesting that a description that requires an explanation is not a good description.

The idea of following the actors, and thereby avoid having to provide theories on the field, does not purport to serve as encouragement to researchers to produce studies devoid of theory, which are justifiably criticized by the academic community [40]. On the contrary, such a suggestion leaves open the possibility of deliberating over issues that emerge during the course of the research [40]. However, reporting on a study merely by means of a description can become an impossible task. Thus, some authors suggest an integration of ANT with other theoretical perspectives [9]. This matter is not a general consensus in academic debates, leaving room to the researcher to decide whether to follow only ANT premises, or to seek support in other research approaches as well.

Another criticism relates to the linearity of the translation process which, although focusing on the convergence of preferences, mimics a functionalist concept [36]. ANT does not presuppose the existence of previously-established social rules, nor does it exclude them, whereby various negotiations and exchanges between the actors are necessary to ensure that their preferences are made to converge to an OPP [4]. Thus, a translation is not everlasting, since the tensions between the actors can unravel a network that has been previously established. As noted by Callon [4], such tensions between the actors continue to be present, since the previously established network may disentangle as the result of a succession of unexpected events. That is to say, an initially established OPP may no longer be attractive to the actors, which results in the unraveling of the network.

In ANT-based e-government studies, attempts have been made to ensure that the implementation of systems matches the four moments of translation [13, 16, 19, 21]. However, it is important to take into consideration that, although a seminal study on ANT has proposed these four moments of translation, such moments may not necessarily appear in all situations, or they may even occur at once. While taking into consideration the empirical freedom of ANT and defending the exploration of new theoretical frontiers, Law [41] contends that ANT is a way of representing the world in different ways, going beyond Euclidean space. In other words, in the same way that representations of actor networks were constructed [4, 25], there is also room to explore other ways to represent heterogeneous relationships.

However, the latest ANT developments have still not been absorbed by the IS and e-government academic community. When criticizing the term ANT, Latour [41, p. 24] states that: "yes, I think there is life after ANT [...], thus abandoning what is so wrong with ANT, that is 'actor,' 'network,' 'theory' without forgetting the hyphen! – some other creature will emerge, light and beautiful, our future collective achievement." Basically, this provocation is actually an invitation to embark on a continual process of collective construction of a theoretical approach to the study of society.

This essay therefore provides an incentive for e-government researchers exploring new directions for ANT to go beyond the moments of translation, as well as bring new concepts to investigate this topic.

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