Introduction

APPLICATIONS OF ACTOR-NETWORK THEORY

Applications of Actor-Network Theory: Socio-Technical Research

Socio-technical research deals with issues involving both people and machines and with the interactions between various human and non-human entities (Tatnall 2011). Many situations need to deal with both people and things and the interactions and relationships between them. Various approaches to socio-technical research attempt to handle these situations in a way that gives appropriate credit to both the social and the technical, but they do this in different ways. In this article I will begin by briefly examining three approaches to socio-technical research, then concentrate on the use of Actor-Network Theory (ANT). I will provide a few examples from the founders of ANT then attempt to categorise the ANT articles from the International Journal of Actor-Network Theory and Technological Innovation (IJANTTI) over the last few years.

There are a number of approaches to socio-technical research but in this article I will consider only three: Activity Theory (Kaptelinin and Nardi 2006; Hashim and Jones 2007), Structuration Theory (Giddens 1984; Turner 1986) and Actor-Network Theory (Latour 1986; Law 1986; Callon 1999).

Activity Theory

Activity Theory is based upon the 1920s work of Russian developmental psychologist Aleksei Leontiev (Verenikina 2001). Hashim and Jones (2007) describe Activity Theory as a theoretical framework that can be used in the analysis and understanding of human interaction through use of their artefacts and see it as the integration of technology as tools which mediate social action. Kaptelinin and Nardi (2006:31) describe Activity Theory as an approach: “... that aims to understand individual human beings, as well as the social entities they compose, in their natural everyday life circumstances, through an analysis of the genesis, structure and processes of their activities”. In Activity Theory, an activity is seen as the basic unit of analysis and one which is used to understand individual actions (Hashim and Jones 2007). Activity theory considers an entire system and not just a single actor and accounts for the environment, history, culture, motivation and complexity of the person and artefact (Kuutti 1996). Morf and Weber (2000:81) put it this way: “Activity theory is a conceptual framework based on the idea that activity is
primary, that doing precedes thinking, that goals, images, cognitive models, intentions, and abstract notions like ‘definition’ and ‘determinant’ grow out of people doing things’. Kaptelinin and Nardi (2006) note that in Activity Theory, apart from their activities no properties exist of either the subject or object. An article from IJANTTI: ‘Mediated Action and Network of Actors: From Ladders, Stairs and Lifts to Escalators (and Travelators)’ by Samuel Ekundayo and Antonio Diaz Andrade (2011) from New Zealand offers a comparison of Activity Theory and Actor-Network Theory.

Structuration Theory

For Giddens (1984), Structuration Theory presents a focus on social processes that involve the interaction between actors and the structural properties of a system. Structuration Theory considers agents as a source of power. An agent can be a person, but also anything with the capability to exert power; anything that can influence others in a social context. Giddens sees ‘power’ as an actor’s capability to encourage decisions in a way favourable to them. He sees power, not as a resource but as something used mainly as a medium for power. Human agency can be seen to represent the capacity to make a difference and influence the outcome in a given situation. Structures are rules and resources (Turner 1986), the means and medium through which power is exercised, and are instantiated in recurrent social practices (Iyamu 2013). Orlikowski (1992) notes that Structuration Theory investigates the creation and reproduction of social systems and focuses on social factors including both agents and structure without giving greater importance to one or the other. Structures do not exist independently but are enacted by human agents who continually produce and reproduce these structures. An IJANTTI article by Tiko Iyamu and Dewald Roode (2010): ‘Structuration Theory and Actor-Network Theory for Analysis: Case Study of a Financial Institution in South Africa’ provides a comparison between Structuration Theory and Actor Network Theory.

Actor-Network Theory

Actor-Network Theory (ANT), or the ‘sociology of translations’, originated from research in the social studies of science in the 1980s, its designers and main proponents being Bruno Latour, Michel Callon and John Law (Callon 1986b; Latour 1986; Law 1986). ANT was designed as an approach to socio-technical research that would treat the contributions of both human and non-human actors fairly and in the same way, and in an ANT framework, nothing is purely social and nothing is purely technical. ANT is concerned with studying the mechanics of power as this occurs through construction and maintenance of networks made up of both human and non-human actors (Al-Hajri and Tatnall 2011; Tatnall and Dakich 2011). In actor-network theory, “…the extent of a network is defined by the presence of actors that are able to make their presence individually felt.” (Law 1987b:21). An actor is made up only of its interactions with these other actors, and a network can be hidden inside a ‘black box’ when its internal details are not under investigation (Davey and Tatnall 2013). ANT investigates the construction and maintenance of networks made up of both human and non-human actors and attempts impartiality towards
all actors in consideration, whether human or non-human. It makes no distinction in approach between the social, the natural and the technological (Tatnall and Dakich 2011). ANT is based on three principles:

- Analytical impartiality is demanded of all actors, whether they be human or non-human
- Generalized symmetry explains conflicting viewpoints of different actors making use of the same vocabulary
- Elimination of all a priori distinctions between the technological and the social.

The rule which we must respect is not to change registers when we move from the technical to the social aspects of the problem studied. (Callon 1986b, p. 200)

Although there is value in both Activity Theory and Structuration Theory, the remainder of this article deals only with Actor-Network Theory.

Research Using ANT: Some Classical Examples

The work of Latour, Callon and Law provide some classical examples of how actor-network theory can be used productively to explore socio-technical situations. I will mention just a few.

In ‘The Case of the Electric Vehicle Callon’ (1986a) describes how, in 1973, EDF (Electricité de France) came up with a plan for the VEL (vehicule electrique). EDF prescribed both the precise details of this vehicle and also the social situation in which it would operate. Callon describes the ‘ingredients’ of the electric vehicle as: “... electrons that jump effortlessly between electrodes; the consumers who reject the symbol of the motor car and who are ready to invest in public transport; the Ministry of the Quality of Life which imposes regulations about the level of acceptable noise pollution; Renault which accepts the fact that it will be turned into a manufacturer of car bodies; lead accumulators whose performance has been improved; and post-industrial society which is on its way.” (Callon 1986a, p. 23). He argues that the ‘co-operation’ of every ingredient with every other is important, and that in the absence, or lack of co-operation of any one of these ‘actors’ the whole VEL would break down.

Another article by Callon (1986b): ‘Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay’ describes the attempts of three marine biologists to determine the reasons and find a solution to the decline of the number of scallops in St. Brieuc Bay, France. Callon describes how, at a 1972 conference in Brest, scientists and representatives of the local fishing community sought the means to increase production of scallops by controlling their cultivation. Discussions at the conference involved three points: firstly, in Japan scallops are intensively cultivated with their larvae being anchored to collectors to provide shelter from predators before later being harvested, secondly there is very little knowledge of the mechanisms by which the scallops develop and thirdly fishing had been so intensive that its consequences were apparent.

The article then introduces the concept of Innovation Translation with its four ‘moments’: Problematisation, Interessement, Enrolment and Mobilisation and uses these to describe what happened in St Brieuc Bay.
In ‘Technology and Heterogeneous Engineering: The Case of Portuguese Expansion’, Law (1987a) examines Portuguese exploration down the African coast on the way to India and how King Henry the Navigator acted to facilitate this. Law describes the actors as including: the boats, the crew, supplies, masters of the vessels, Cape Bojador (point of no return) and ocean currents. In describing the part played by the Portuguese King he suggests that: “I call such activity heterogeneous engineering and suggest that the product can be seen as a network of juxtaposed components.” (Law 1987a, p. 3).

In ‘Engineering and Sociology in a Military Aircraft Project: A Network Analysis of Technological Change’ (Law and Callon 1988) and ‘The Life and Death of an Aircraft: A Network Analysis of Technical Change’ (Law and Callon 1992), the authors describe the ill-fated British Aircraft Corporation TSR2 Cold War strike and reconnaissance military aircraft project in the UK in the early 1960s. The article considers two actor-networks, an external network made up by the Defence Ministry, Navy and Government bureaucracies, and an internal network comprising the contractors and the Air Ministry and argues that it is not just the technical features but also human factors that determine the outcome: “… we must study not only the social but also the technical features of the engine’s work; in other words, we have to understand the content of engineering work because it is in this content that the technical and the social are simultaneously shaped.” (Law and Callon 1988, p. 284). “Our object, then, is to trace the interconnections built up by technologists as they propose projects and then seek the resources required to bring these projects to fruition.” (Law and Callon 1988, p. 285).

Perhaps my favourite is: ‘Aramis or the Love of Technology’ by Bruno Latour (1996). The book tells the story of a revolutionary ‘guided-transportation’ system intended for the Petite Ceinture district and to become part of the Parisian public transportation system in the 1970s. Apart from its allusion to The Three Musketeers, ‘Aramis’ is an acronym for ‘Agencement en Rames Automatisées de Modules Indépendants dans les Stations’ (Arrangement in Automated Trains of Independent Modules in Stations). The idea was to produce a system that combined the flexibility of a car with the efficiency of a railway. Work on Aramis began in 1969 but was abandoned in 1987. The book takes for form of a detective story and tells the story of Aramis simultaneously from several different perspectives using a number of different ‘voices’. A young engineer and the sociologist, Norbert, conducting the investigation carry the story line. The engineers and administrators who worked on Aramis speak through both interviews and documents. The ‘author’ interjects from time to time to provide a sociological commentary, and later Aramis speaks on its own behalf, bewailing its fate

**Research Using ANT: Some Examples from IJANTTI**

The *International Journal of Actor-Network Theory and Technological Innovation* (IJANTTI) has, since 2009, acted as a vehicle for the publication of articles both on approaches to technological innovation and also, more importantly in regards to this article, on actor-network theory (ANT). In this section I will attempt a categorisation in terms of research subject of the articles published from 2009 to 2013. I will, here, include only those dealing with ANT which I have categorised as from the fields of: Information Systems, Healthcare, Education, Business, eGovernment, Science and Engineering and other miscellaneous topics. It should be noted that this
categorisation is, at best, somewhat subjective as many of the articles cover more than a single field, and some also look at the application of ANT itself. Much socio-technical research using ANT is cross-disciplinary and so covers multiple fields.

**Information Systems (IS) / Information and Communication Technology (ICT and IT)**

While there were few articles relating to both information systems and actor-network theory before the mid-1990s, in recent times the number has increased dramatically. In relation to IJAN-TTI, the category of information systems (information technology) is the largest, comprising 25 articles. There is, however, considerable overlap between this category and that of business, given that many of the applications of information systems are in business.

Many of the articles in this category deal with general aspects of the field of information systems while some look at specific examples. Relating to overall aspects of this field, ‘Have you taken your Guys on the Journey? – An ANT Account of IS Project Evaluation’ (Cecez-Kecmanovic and Nagm 2009) deals with ANT and IS project evaluation research. An article by Amany Elbanna: ‘Actor-Network Theory in ICT Research’ also deals with this topic. ‘Having a Say: Voices for all the Actors in ANT Research?’ (Kennan, Cecez-Kecmanovic and Underwood 2010) deals with the issues associated with giving non-human actors a voice of their own in ANT based research. A number of articles, such as ‘Linux Kernel Developers Embracing Authors Embracing Licenses’ (Linden and Saunders 2009) look at specific topics with this field.

Several business-related articles use ANT to consider enterprise IT issues. These include: ‘Theoretical Analysis of Strategic Implementation of Enterprise Architecture’ (Iyamu 2010), ‘Institutionalisation of the Enterprise Architecture: The Actor-Network Perspective’ (Iyamu) and ‘Information Infrastructure: an Actor-Network Perspective’ (Cordella 2010). As mentioned earlier, one article compares Structuration Theory and Actor Network Theory and this is in the context of information systems. In ‘The Use of Structuration Theory and Actor-Network Theory for Analysis: Case Study of a Financial Institution in South Africa’ Tiko Iyamu and Dewald Roode (2010) note that many organisations are increasingly dependent on their IT strategy both to increase their competitiveness or just to survive. They point out that despite this, little is known about the non-technical factors, such as people, and their impact on the development and implementation of IT strategy. Making use of both Structuration Theory and Actor-Network Theory they analyse how non-technical factors influence IT strategy. IS Project management is another significant with articles including: ‘Assessment of Risk on Information Technology Projects through Moments of Translation’ (Iyamu) and ‘Critical Success factors in the Management of Projects Using Innovative Approaches’ (Bali and Wickramasinghe 2010).


**Business and Government**

‘Actor-Network Theory for Service Innovation’ by Lorna Uden and Janet Francis (2009) from the UK looks at the growth of the service sector as the dominant industrial world economy, and how there is a need for new conceptual understandings and theoretical underpinnings to systematically describe its nature and behaviour. They point out that the development and adoption of service innovation requires the integration of multiple elements, including people, technologies and networks across organisations. The article describes how ANT can help in an understanding of the relationships among the actors and how these actors have their needs shaped by the network formation. On a similar note, in an article titled: ‘Service Science: An Actor-Network Theory Approach’, Noel Carrol, Ita Richardson, and Eoin Whelan from Ireland note that service networks that implement technology to execute processes to deliver a specific service become increasingly complex, and how ANT can be used to examine their complexity. Given their, they describe ‘service’ as comprising socio-technical factors which exchange various resources and competencies, and use service networks to transfer resources and competencies.

Spanning both information systems and business is an article by Fabian Muniesa, from France. Through a case study on the Arizona Stock Exchange ‘Is a Stock Exchange a Computer Solution? Explicitness, algorithms and the Arizona Stock Exchange’, the article looks at how computerisation and automation challenged the definition of the stock exchange in the context of North-American financial markets in the nineteen-nineties. Muniesa notes that for a market to be formulated in algorithmic terms implies in part the possibility of being ‘executed by a machine’. Also relating to financial markets, ‘Actor-Network Theory and the Online Investor’ by Arthur Adamopoulos, Martin Dick and Bill Davey (2012) from Australia offers an understanding of the way in which technology is used, rather than adopted and involves interactions between people and the Internet. They describe an interesting confirmation of the power of allowing non-human actors to be heard and how, in this case, as the non-human actor (on-line services) changed over the course of the investigation it became clear that the human actors were changing as a result. They found that the human actor had been translated to a more active and involved investor due to the change in the online services that are available.

‘Neither Heroes nor Chaos: The Victory of VHS Against Betamax’ by Diego Ponte and Pier Franco Camussone (2013) from Italy sets out to contribute to the ongoing debate on standardisation processes by addressing economic and social aspects that shape creation and diffusion of standards. Their topic is the contest of videotape formats VHS and BETAMAX in the 1970s.
and 1980s. They demonstrate how the evolution of a standard is a complex process where creation and diffusion are co-evolving dimensions that cannot easily be distinguished and how the coupling of economic and social aspects permits a better understanding of the factors and events that affect the evolution of a standard and the dominance of one standard among competing ones. In an article relating to both information systems and business: ‘Competitive Intelligence in the Enterprise: Power Relationships’, Relebohile Moloi from South Africa and Tiko Iyamu from Namibia examine factors that may lead to decisions in choosing Competitive Intelligence products in organisations. An article: ‘Using Actor Network Theory to Facilitate a Superior Understanding of Knowledge Creation and Knowledge Transfer’ (Wickramasinghe, Tatnall and Bali) argues that as current knowledge creation techniques tend to focus on either human or technology aspects of organisational development and less often on process-centric aspects of knowledge generation, it is important to view knowledge creation and all socio-technical organisational operations that result in knowledge generation through the richer lens of ANT.

Johanes Eka Priyatma from Indonesia and Zainal Abidin Mohamed from Malaysia point out that leadership has been identified as a factor critical to successful development of e-government projects. They further note that this is especially the case in developing countries. In their article: ‘Opening the Black Box of Leadership in the Successful Development of Local E-Government Initiative in a Developing Country’ they make use of the four moments of innovation translation as a framework to trace and monitor how leadership has been practiced effectively in an e-government project in a developing country. In another article, ‘A Critical Review of the Ontological Assumptions of Actor-Network Theory for Representing E-Government Initiatives’ Johanes Eka Priyatma suggests that the potential contribution of ANT for representing e-government initiatives flows from its ontological assumptions, but that these assumptions have never been critically reviewed using real e-government cases. The article then examines two e-government cases from Indonesia to achieve this.

**Healthcare**

A substantial number (12) of articles relate to ANT and healthcare. ‘The S’ANT Imperative for Realizing the Vision of Healthcare Network Centric Operations’ (Wickramasinghe and Bali 2009) argues that in the information-intensive environment of healthcare a network-centric approach offers rapid sharing of information and the effective knowledge building required for development of coherent objectives and their attainment. The article suggests the use of rich analysis tools from Social Network Analysis combined with Actor-Network Theory (S’ANT). Along a similar line is ‘The S’ANT Approach to Facilitate a Superior Chronic Disease Self-Management Model’ (Wickramasinghe, Bali and Goldberg).

‘Actor-Network-Theory in Medical e-Communication – The Role of Websites in Creating and Maintaining Healthcare Corporate Online Identity’ (Bielenia-Grajewska 2011) deals with how websites create and maintain the online identity of medical care providers. The author notes that she has chosen an ANT approach as this makes it possible to study the role of living and nonliving entities in shaping the online identity of healthcare suppliers and to concentrate on the networks and systems within e-healthcare as well as the flows and interrelations constituting it.
ICT has been used in medical General Practice throughout Australia for some years, but although most General Practices make use of ICT for administrative purposes such as billing, prescribing and medical records, many individual General Practitioners themselves do not make full use of these ICT systems for clinical purposes. This issue is discussed in the article: ‘Adoption of ICT in Rural Medical General Practices in Australia – an Actor-Network Study’ (Deering, Tatl and Burgess 2010) in which an ANT lens is used to examine the human and non-human actors that contribute to this situation.

‘The (Re-)Socialization of Technical Objects in Patient Networks: The Case of the Cochlear Implant’ (Spöhrer 2013) describes the processes of technical stabilization of the cochlear implant in certain stabilised scientific environments. The author notes that there is a problem here as these technical stabilisations can only be accomplished by rigorously excluding attributes of the social, but that as the cochlear implant is born out of the need to enable participation in ‘normal’ social life it is certainly a social actor attributed with certain social attachments.


Education

Education is another popular area for ANT research with 15 articles in this category. A number of these articles refer to university education and some to schools. Beginning with university education, focussing on assessment of one teacher-training course for the learning and skills sector in the UK, ‘Higher education in further education in England: an actor-network ethnography’ (Tummons 2009) offers a way to conceptualise the responses of those Further Education colleges where the course is actually run, to the systems and procedures established by the university which provides the course.

‘Knowledge in Networks – Knowing in Transactions?’ (Rimpiläinen 2011) investigates a large, publicly-funded interdisciplinary project undertaken at a university in Scotland. The specific focus of the article is what might be termed the epistemology of actor-network theory, and the paper goes on to consider the implications for epistemology of one of the more significant elements of ANT: the principle of symmetry. In ‘Distance, climate, demographics and the development of online courses in Newfoundland and Labrador’ (Reid 2013) the author notes that one of ANT’s assertions is that physical factors can be actors within a network of other factors and determine development and use of technology. The article documents the impact of climate, distance and demographics on the adoption of online courses at a university in Canada.
An interesting article: ‘Between Blackboxing and Unfolding: Professional Learning Networks of Pastors’ (Reite 2013) points out that pastors can be thought of as an example of a value-oriented profession being both a keeper of traditions and an innovator facing the challenges of globalisation and secularisation. The analysis of pastor networks is therefore an interesting case of professional learning in a changing society, and the author presents an ethnographic study of five pastors from the Church of Norway doing their everyday work. The article argues that professional learning is a process of moving between ‘black boxing’ and ‘unfolding’.

There are also several examples of relating ANT to school education. ‘“What’s Your Problem?” ANT Reflections on a Research Project Studying Girls Enrolment in Information Technology Subjects in Post-compulsory Education’ (Rowan and Bigum 2009) notes that despite more than 30 years of gender reform in schools, the number of girls enrolled in information technology subjects in the post-compulsory years of education has remained under 25%. The authors discuss the difference between the researchers’ perception of the problem under consideration, and the participants’ perception of the same issue using ANT to highlight the gaps, tensions and contradictions within the data and to ask key questions about the extent to which the enrolment of girls in IT is indeed ‘a problem’.

In ‘A Petri Net Model for Analysing e-Learning and Learning Difficulties’, Tas Adam (2011) examines the issue of using an actor-network framework to develop a model for e-Learning for students with Learning Difficulties. In the article Adam points out that Petri Nets are tools for the modelling and analysis of the behaviour of systems and can reveal important information about the structure and dynamic behaviour of the modelled system. He argues that Petri Net concepts (when used qualitatively) are not fundamentally different from those of ANT. A related article: ‘School Children with Learning Disabilities: An Actor-Network Analysis of the Use of ICT to Enhance Self-Esteem and Improve Learning Outcomes’ (Adam and Tatnall 2012) presents a report on an investigation into the use of ICT to aid in the education of students with Learning Disabilities.


Science and Engineering

This is not an area with a large number of ANT articles, despite two of Latour’s early ANT works relating to science. ‘Science in Action’ (Latour 1987) describes how, as well as technical factors, social context is important to an understanding of how science works. Latour argues that science and technology need to be studied ‘in the making’, or while in action to see why
scientific discoveries could have moved in different directions. Similarly, ‘The Pasteurization of France’ (Latour 1988) suggests that in this case what matters is the role of each actor and how they play a role in power relationships, rather than whether these actors are microbes, scientists or bureaucrats.

Having said that the number of articles on Science and Engineering is small in number, they make very interesting reading. I have classified six articles as being relevant to this field. The first, ‘Opening the Indonesian Bio-Fuel Box: How Scientists Modulate the Social’ by Yuti Ariani and Sonny Yuliar uses the notion of translation to study present bio-fuel developments in Indonesia. The authors identify the actors as including: scientists, businessmen, policy makers, farmers, the land itself, bio-fuel, oil and politicians. Their article describes how scientists seek to establish their role through a heterogeneous network modulating the social, the politics and the trajectory of bio-fuel development in Indonesia (Ariani and Yuliar 2009). Fernando Gonçalves and José Figueiredo from Portugal have contributed three important articles relating to engineering and the process of engineering design. In: ‘How to Recognize an Immutable Mobile When You Find One: Translations on Innovation and Design’ (Gonçalves and Figueiredo 2010) they explore some ways to build practical methodological approaches into engineering design, discussing in particular Obligatory Passage Points and Immutable Mobiles. In two more articles they discuss ‘Negotiating Meaning – an ANT Approach to the Building of Innovations’ and ‘Engineering Innovative Practice in Managing Design Projects’.

Other Topics

A number of articles do not fit neatly into any of the above categories and are included here. Florian Neisser from Germany has contributed an article titled: ‘Fostering Knowledge Transfer for Space Technology Utilization in Disaster Management – An Actor-Network Perspective’ (Neisser 2013). He points out that, due to the human and property costs, it is important that efforts to mitigate potential, and respond to actual disasters, be coordinated and that Disaster Management is an issue of global importance. The article describes a study of the design and use of a web-portal to handle the complex and constantly changing interrelations between human and non-human actors and provide timely and accurate information as well as clear and suitable communication technology to guarantee coordinated efforts. ‘The Iranian Wheat Growers’ Climate Information Use: An Actor-Network Theory Perspective’ by Maryam Sharifzadeh et al. from Iran (2012) relates a study of agricultural climate information use, linking actor-network theory and actor analysis premises in a qualitative research design. The study’s findings showed that socio-political factors: farmers’ awareness, motivation and trust, along with information processing factors including accuracy of information, access to information, and correspondence of information to farmers’ conditions were the key elements in facilitating climate information use in farming practice.

In ‘Actor-Network Theory in Intercultural Communication – Translation through the Prism of Innovation, Technology, Networks and Semiotics’ Magdalena Bielenia-Grajewska discusses the role of participants in one type of intercultural exchange, namely in translation (Bielenia-Grajewska 2009). ‘From Intermediary to Mediator and Vice Versa: On Agency and Intentionality of a Mundane Sociotechnical System’ (Antonio Diaz Andrade) examines the use of electronic
mail systems, especially the automatically generated ‘Out of Office’ message, is examined in this article to emphasise the distinction between agency and intentionality. In ‘Networks, agents and models: objections and explorations’, Muniesa and Tchalakov uses the form of a dialog to argue that critical problems of computational modelling of network topologies can be well considered from an ANT point of view.

In ‘Imagining a Feminist Actor-Network Theory’ Andrea Quinlan (2012) points out that Feminism and Actor-Network Theory have often been considered opposing theoretical and intellectual traditions, but goes on to imagine a meeting between these seemingly divergent fields and consider the theoretical and methodological challenges that ANT and feminism raise for one another. ‘Murphy’s Law in Action: The Formation of the Film Production Network of Paul Lazarus’ Barbarosa (1982): An Actor-Network-Theory Case Study’, by Markus Spöhrer explores the possibilities of ANT as a methodological approach to Production Studies. Using a detailed production log written by producer Paul Lazarus III, the coming-into-being of the film Barbarosa (1982) is described.

**Technological Innovation Using Other Investigative Frameworks**

In investigating technological innovation several other articles made use of approaches, principally Innovation Diffusion (Rogers 2003), the Technology Acceptance Model (Davis 1986), hermeneutics/phenomenology and variations on these, rather than innovation translation. These articles were contributed by: Tatnall, Alawneh and Hattab, Kripanont and Tatnall, Bingley and Burgess, Tatnall, Lukaitis. Although these were interesting and worthwhile articles they will not be considered here as they do not relate directly to ANT.

**Re-Analysis Using ANT**

Several articles show how it is possible to do some ‘after the fact’ re-conceptualisation and re-analysis of the data from other approaches to technological innovation to make use of an innovation translation approach. Of course, if an ANT approach is to be used in any research project then ideally it would be used from the beginning of the study so that the data collection and interviews reflected the sort of questions and the approach appropriate to this framework. Nevertheless the following articles, all originally making use of an approach to technological innovation based on TAM, the Technology Acceptance Model (Davis 1986) show that re-interpretation is possible and even worthwhile.

‘A Socio-Technical Study of the Adoption of Internet Technology in Banking, Re-Interpreted as an Innovation Using Innovation Translation’ by Salim Al-Hajri and Arthur Tatnall took a study using TAM that investigated Internet banking in Oman and Australia and re-interpreted it using innovation translation. Another article: ‘Knowledge Conversion Processes in Thai Public Organisations Seen as an Innovation: The Re-Analysis of a TAM Study Using Innovation Translation’ by Puripat Charnkit and Arthur Tatnall took a similar line to re-interpret a TAM study relating to knowledge management in Thailand. Also relating to Thailand, ‘Technological Innovation and the Adoption and Use of ICT in Thai Universities’ by Arthur Tatnall took an article that originally used by TAM and Structured Equation Modelling and performed a similar re-interpretation.
CONCLUSION

In this article I have demonstrated the wide and multi-disciplinary nature of research framed by actor-network theory, and how the articles from IJANTTI cover a broad scope. The classification of ANT research applications presented here is, as previously mentioned, at best rather subjective as many articles span more than a single topic and are really cross-disciplinary. The largest number of IJANTTI articles came from the fields of Information Systems, Healthcare and Education, but a significant number also came from a variety of other areas. There are, however, still major areas that have not, as yet, attracted many IJANTTI articles. One of these is history of technology and events, despite the early classic articles by the founders of ANT relating to this area. Other possible opportunities for further ANT research publications include more articles on science and engineering, and articles on gardening, entertainment and many other areas. Since its initial conception 30 years ago, ANT has gone on to offer an important framework for much socio-technical research.

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REFERENCES


