Chapter 14
Actor-Network Theory to Assist in Understanding the Implementation and Adoption of Health Information Systems

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14.1 Background

Globally, governments are increasingly investing in healthcare information technology (HIT), with an emphasis on electronic health records. This is in response to the immense and diverse pressures of changing patient demographics, healthcare services provision, financial implications, workforce shortages, advancements in medical technologies and their impact on healthcare demand and delivery as well as a move towards a system where interaction between healthcare providers and consumers can achieve maximum output with limited human and financial resources (Wickramasinghe and Schaffer 2010).

Healthcare services are very well established as an information-rich industry (ibid). The motivating notion in support of the introduction of IT (information technology) in healthcare service delivery is that if we can improve the ways of accessing and sharing information across healthcare systems by moving away from pen, paper and human memory towards a new environment, where key stakeholders (e.g. service providers, consumers, government agencies and healthcare managers) can reliably and securely share information electronically, health outcomes and quality of care can be improved significantly (Mort et al. 2009).

Use of HIT can also help with cost savings, improve patient involvement and produce useable secondary data for further research and training (Car et al. 2008). However, the transformation from cabinets and paper files to computers and HIS software is not a candid proposition and is sometimes faced with many known and unknown hurdles, such as technological, organisational, financial and people issues, as a result of the complex and multifaceted environment of healthcare service

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delivery where different human and non-human actors interact with each other in very complex ways (Ammenwerth et al. 2006; André et al. 2008; Catwell and Sheikh 2009; Cresswell et al. 2010; DesRoches et al. 2008; Lorenzi et al. 2009).

Given the inherent complexities of healthcare operations, it is argued in this chapter that human and non-human actor interactions are challenging and need to be evaluated with theoretically informed techniques (Wickramasinghe and Schaffer 2010). One approach identified in the literature used to facilitate correct and accurate capturing of the complexities and levels of interactions in healthcare operations is to use an ANT (Muhammad et al. 2012; Cresswell et al. 2010; Wickramasinghe et al. 2009).

To determine the functionality of a system, it is important to understand the fit between technical subsystems and social subsystems in an organisation (Mitchell and Nault 2008). The emphasis is then not only on studying the impact of the technology on organisations and their work processes but also on the impact of social and people issues pertaining to technology and work processes (Cresswell et al. 2010). For this reason, it is also important to understand the interrelationship and interactions of the technical and social systems between each other (Coiera 2004). The lens of actor-network theory (ANT) is useful in such contexts as it can be applied to analyse the data collected during the research. This can assist the researcher to understand the user requirements, their perceptions and expectations from the HIT implementation and to understand their needs and intentions to adopt the new e-health system.

This chapter shows the benefits of applying an actor-network theory (ANT) lens of analysis to the collective data set to further understand the richness of the actor-network theory (ANT) and potential challenges, complications and general complexities of any/all people/technology interactions as the HIS implementation and adoptions move forward to a large-scale implementation. We believe that this can be achieved by the incorporation of an ANT analysis as is illustrated in this chapter, and by doing an ANT analysis a successful and more realistic mapping of the rich and complex environment which ultimately will ensure the appropriate design, development, implementation and adoption of the HIS solution will be enabled. This process serves to illustrate the power of such an ANT analysis for a healthcare delivery context.

Healthcare systems are complex systems especially when they integrate with information technology. This environment is further complicated by the interaction of different human and non-human actors that often leads to failed technology-based healthcare interventions and implementations which are also costly and have far-reaching impacts (Cresswell et al. 2011). Thus, it becomes necessary and important to evaluate these interventions with theoretically informed techniques to enable a deeper understanding which in turn can facilitate a successful implementation and adoption of the intended health information technology (Cresswell et al. 2011).

We contend that a sociotechnical systems perspective can provide the foundations for a fuller understanding so that there is a better evaluation and provision of specific solutions to address gaps in their current development, implementation and adoption. Furthermore, it can also enhance our understanding by providing a

mechanism to study the relationships between technology organisation, people and social and financial factors that influence the success of e-health implementation and adoption. We believe that a viable healthcare system can only be achieved if these considerations are jointly optimised.

14.2 Actor-Network Theory (ANT)

Actor-network theory (ANT) is a sociological theory developed by French sociologist Bruno Latour and Michel Callon and British sociologist John Law (Latour 2005; Law and Hassard 1999; Muhammad et al. 2013). Its fundamental stand is that technologies and people are linked in an often-complex network. ANT tries to bridge the gap between a sociotechnical divide by denying the existence of purely social or technical relations. In doing so, it takes a very radical stance and goes as far as challenging many of the conventional epistemological ideas and rejecting any distinction between subject or object, nature or culture and technology and society.

ANT assumes that each entity (such as technologies, organisations and humans) is an actor. Therefore, the actors have the potential to transform and mediate social relationships (Cresswell et al. 2010). ANT further emphasises that entities regardless of their nature, whether human, technologies or process, are not fixed. Thus, they do not have any significance on their own, but rather their significance depends on the nature of their relations with other entities in the network and their role which may change as their relations change (Law 2006). This means that neither actors nor their relations are static and permanent; they change over time and across social and political contexts (Singleton and Michael 1993).

Actors are essentially considered heterogeneous in nature, representing negotiations at different levels (e.g. political, social, technical and/or economic levels). Further, the degrees of commitment, skills, constraints and prejudice among actors also can vary. Often, these represent a mixture of one or two of social, technical or personal levels (Latour 2005). At the technical level, the role of technology may be involved to facilitate users by giving them accurate and up-to-date information when it is needed. The accuracy (effectiveness and efficiency) of the technology would be best determined or disputed by the users (nurses, clinicians, pharmacists and patients). To better understand relationships and how they create meaning and describe the role of different actors (e.g. the patient, GPs, nurses, different diagnostic tests, different medical technologies, different communication channels, standards, protocols and decision-makers and policymakers), ANT suggests we should think in terms of networks of relations or actor networks (Williams-Jones and Graham 2003).

14.3 Key Concepts of ANT

To apply ANT appropriately, it is first necessary to become familiar with the following key constructs and map them with the implementation and adoption of HIS.

Actor/Actant Actors are the web of participants in the network including all human and non-human entities. Because of the strong biased interpretation of the word actor towards human, the word actant is commonly used to refer both human and non-human actors (Wickramasinghe et al. 2012). Examples include humans, organisations, technology, technical artefacts and graphical representations.

Heterogeneous Network A network of aligned interests formed by the actors/actants. This is a network of materially different actors that is achieved by a great deal of work that both shapes those various social and nonsocial elements and disciplines them so that they work together, instead of making off on their own (Wickramasinghe et al. 2012).

Tokens/Quasi Objects Created through the successful interaction of actors/actants in a network and are passed between actors within the network. As the token is increasingly transmitted or passed through the network, it becomes increasingly punctualised and increasingly reified especially when the token is decreasingly transmitted or when an actor fails to transmit the token (Wickramasinghe et al. 2012).

Punctualisation Central to ANT. Within the domain of ANT, every actor/actant in the web of relations is connected to others and will be considered as a single object or concept in the same way as the concept of abstraction is treated in object-oriented programming. These sub-actors are sometimes hidden from normal view and can only be viewed in the case of a network breakdown. This concept is often referred as a depunctualisation. Because ANT requires all actors or sections of a network to perform required tasks and therefore maintain the web of relations, this becomes more focused when a breakdown in the network occurs. In case any actor ceases to operate or maintain its link, the entire actor network would break down resulting in punctualisation. Punctualisation is thus a process and cannot be achieved indefinitely rather it is a relational effect and is recursive in nature (Law and Hassard 1999).

Obligatory Passage Point (OPP) Broadly refers to a situation that must occur for all the actors to satisfy the interests that have been attributed to them by the focal actor. The focal actor defines the OPP through which the other actors must pass through and by which the focal actor becomes indispensable (Callon 1986).

Irreversibility The degree of irreversibility depends on the extent to which it is subsequently impossible to go back to a point where that translation was only one among others (Callon 1986) and the extent to which it shapes and determines subsequent translations (Latour 2005).

Given the very complex nature of healthcare operations (Lubitz and Wickramasinghe 2006), irreversibility is generally not likely to occur. However, it is vital that chains of events are continuously analysed in order that future events can be addressed as effectively and efficiently as possible.

To realise the importance of the application of ANT into the study of evaluation of the implementation and adoption of HIS, it is important to understand the key concepts of ANT and map them to the critical issues endured in HIS implementation and adoptions. An initial assessment of these key concepts and their mapping is provided in Table 14.1.

Irreversibility In the context of a very complex nature of healthcare operations, irreversibility is very less likely to occur and would be more dependent on social networks and the nature of interaction between human and non-human actors in the network. Here it is important to remember though the chain of events needs to be monitored carefully so the future events can be addressed in best possible manners.

14.4 Actor Networks

Actor networks are highly dynamic and inherently unstable in their nature. Understanding the alignment between people, technology, their roles, routines, values, training and incentives and the role of technology and how it can facilitate or negatively impact the work processes and tasks in an organisation can serve to stabilise these networks (Greenhalgh and Stones 2010; Wickramasinghe et al. 2011). Actor networks need to be continually maintained through the engagement (e.g. a process known as enrolment in ANT) of the different actors/actants involved in the process.

At times, actor networks may fail and hence may need to be replaced by other networks or by integrating new enrolments. The enrolment of new actors/actants leads to the reconfiguration of the networks as interests are translated to suit the needs of the wider body of actors. These actors then take part in a negotiation process to define the new identity of the actor networks. In this process, importance is placed on the actions of actors and networks and the interactions between different actors (e.g. social institutions, individuals, government, technology, communication channels, rules and regulations, protocols and work environment) (Wickramasinghe et al. 2011; Muhammad et al. 2013).

The origin of power and structure are the main sources and drivers of the existence of such actor networks. Thus, if there needs to be an understanding of the essential dynamics within such an actor network, it is important to understand and consider all the components that collaborate, co-operate and compete to lead to propagation and perseverance of ANT and how to unpack and then understand the underlying process and important components of actors and their networks that are

Table 14.1 Mapping of the HIS Implementation and Adoption with ANT

Key concepts of ANT	Mapping of the HIS implementation and adoption with ANT
Actor/actant	In the HIS context, actors/actants are different stakeholders in healthcare delivery settings such as technology (Web 2.0, databases, graphical user interfaces, IHI and different computer hardware and software) and people (service providers, healthcare funders, healthcare service recipients, healthcare organisations, suppliers and private health insurers as well as clinical administrative technologies, work process and health records) in the form of paper or electronic
Heterogeneous network	The HIS technology here is clearly a network of different applications in this context But it is important to understand that heterogeneous network in ANT requires to conceptualise the network as aligned interest including people, organisations, standards and protocols and their interaction with technology. The key here is a better alignment and representation of interests so the healthcare delivery can be improved
Tokens/quasi objects	In the HIS context, this translates to successful cost-effective and efficient healthcare delivery, such as for GPs treating patient by having a capability of sharing health information with other service providers and for patients who are on long-term medicine having capability to print prescription from home issued by their doctor through the HIS portal. It is important to understand here that to maintain the integrity of the network all the time is very important because if wrong information is passed through the network, the errors would be devastating because they can propagate quickly and will multiply
Punctualisation	For example, a computer on which one is working would be treated as a single block or unit. Only when it breaks down and needs help with spare parts can reveal the hidden chain of network consisting of different actors made up of people, computer parts and organisations. Similarly, in the HIS context, uploading health record of a patient is a consequence of the interaction and coordination of many subtasks. This only can be revealed if breakdown at this point occurs and depunctualisation of the network happens and all subtask would be carefully examined
Obligatory passage point (OPP)	In the HIS context, one can illustrate this by taking the example of access rights. The interface of the system is developed in a way that no service can access any record without using their IHI, which in this case constitute an obligatory passage point through which they must pass for their everyday activities

hidden and cannot readily be seen or understood (Harding 2004; Singleton and Michael 1993).

ANT assists in mapping the actors involved in the development, use and implementation of the HIS at micro, meso and macro levels, as well as the actor network of their engagement and some of the actors' connections. This task is complicated because the actors participate in many networks which may or may not overlap with the introduction of a technology solution nationwide.

Actor networks can be thought of as being fractal and expanding all the time with each actor becoming a node for another network (Law 1999). This complexity

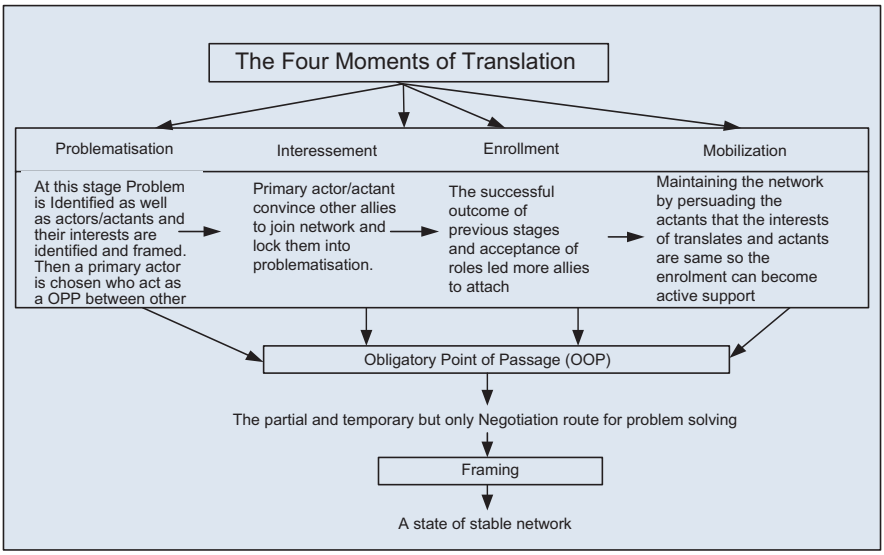

Fig. 14.1 Moments of translation in ANT (adapted from Muhammad et al. (2012))

makes it very difficult to separate the foreground from the background, and such a network is thus challenging to analyse. To overcome this complexity, it is useful to simplify the actor network, and this can be done using the concept of punctualisation or creation of black boxes (Law 2006).

For the purpose of analysis and despite a risk for oversimplification, networks that are stable and strong can be treated as an obligatory passage point (OPP) for some larger networks. The supporting network can then be black boxed. For example, within Fig. 14.1, each box of different levels are complex black boxes, each with its own internal network that can be further expanded or opened to create its own network. The actors of each black box not only interact with each other but also with various actors from additional external networks. Such networks are complex and dynamic in nature. For example, a change (government funding scheme, hospital policy, introduction of a new technology) will impact different actors and their interactions from multiple aspects, and the networks will reorganise and realign as acceptance and/or resistance is manifested.

ANT also advocates a focus on the multiple factors influencing the alignment of linkages between actors and their networks (Mol 2002), but does not emphasise the specific shape or structure of the actor network. For example, in the case of a healthcare decision support system, the technology could be different for different purposes. It may serve the purpose of its targeted audience and be accepted promptly or not serve the purpose and be resisted strongly by other actors. Hence, it is important to understand how actors can be brought together in a network and help them to keep participating in the network. The concept of translation can assist with this task (Law and Hassard 1999).

14.5 Three Stages of ANT

In addition to the aforementioned commentary, it is also necessary to be aware of the three key stages of ANT, which are as follows:

Inscription
Inscription is a process of creating technical text and communication artefacts to protect an actor's interests in a network (Latour 2005; Monteiro 2000; Wickramasinghe and Bali 2009). This is a term used for all text and communication in different media including journal articles, conference papers and presentations, grants proposals and patents. Given the functions of an e-health record in general, the inscription stage is most beneficial to facilitate an in-depth analysis regarding the content of the record and how this is communicated. Inscription takes place during the development of the technological system and its placement into the actor network that means the physical existence of technology is not necessary for inscription to happen. It needs to be convinced once in place and convinced it is forceful enough to be negotiated (Latour 2005). If inscription is strong enough, the program prescribed by it will be followed by other actors (Latour 2005). The stage of inscription starts as soon as system is conceptualised and documented. Inscription can help to understand the underlying assertions of actors; it asserts that technological artefacts always are embedded in developer's beliefs, social norms, user's beliefs and patron of use and assumptions about the system.

Translation
Translation is used to explain the process of creation of actor networks and the formation of ordering effects (Callon and Law 1988; Law 1991). As Latour (2005, p. 64) explains:

> ANT is the name of a movement, a displacement, a transformation, a translation, and enrolment. It is an association between entities which are in no way recognisable as being social in the ordinary manner, except in the brief moment when they are reshuffled together.

At this stage, all actors decide to be part of a specific network if it is worth building (Wickramasinghe and Bali 2009). A good example of this function is the formation of the National E-Health Transition Authority (NEHTA) in the Australian case study and the identification of GPs (general practitioners) as primary actors in the case of the HIS adoption and implementation. Translation is a vital element of ANT. This term is used to explain the process of creating actor networks and the formation of ordering effects (Callon 1986; Law and Callon 1992). The translation stage provides insights into how the HIS system can be integrated into the very complex work environment of healthcare services and delivery.

Translation encourages actors to be involved in the formation of the network and helps the primary actor to overcome resistance. Each actor in the network is an independent entity and regardless of its formation (e.g. a person, group, institute, company, process, hardware or software) will have its own set of diverse interests (Law and Callon 1992). Therefore, the network can only be stable if the interests of different actors can easily and continually be translated (Callon 1986).

The process of translation can also be called a process of negotiation. After the creation of a network, in the presence of many actors, a strong or primary actor would translate the interests of other actors into his/her own by negotiating with the other actors. At this stage, all actors decide to be (or not to be) part of the new network, which is usually dependent on the perceived benefit to themselves (Wickramasinghe and Bali 2009). Among human actors, the translation process is analogous to the negotiation of common interests, whereas the translation among human and non-human actors is typically negotiated through the design of scripts (Callon 1986).

The process of translation of actor/actant interests is achieved through a series of four moments of translation as shown in Fig. 14.1 (Callon 1986):

1. Problematisation
2. Interessement
3. Enrolment
4. Mobilisation

The concept of translation and its four moments is important. This aspect helps the reader to understand how different groups of actors/actants can be brought together to support a common goal and achieve successful enrolment to stabilise the network.

Any resistance to sociotechnical change can be met by reorganising the relations in actor networks and translating their interests into common goals. Counterclaims and disagreements that arise from different actors in a network can harm the stability of the network. In the vision for the HIS, concerns regarding aggravated healthcare costs, disparate patient information system and healthcare quality, safety and efficiency shaped the problematisation stage. The HIS is the primary actor as well as the OPP between other actors. Competing roles between the incoming primary actor (HIS) and the outgoing actor (paper-based documentation) require that links between the latter (paper) and other actors (e.g. nurses, medical staff, allied health professionals and patients) are weakened. In addition, the ties (interests) between the incoming actor (HIS) and the other actors need strengthening, through interessement, to be successful. If this process succeeds, then it can facilitate the enrolment stage in which actors accept and align their positions in new networks where the actor paper-based documentation leaves and the HIS enters. Mobilisation happens when the new networks become active and stable with the new actor.

The foundation of networks is built upon the rules of interactions between actors. Therefore, continuous translation of interests at different levels is a primary source of social order. It is therefore also important to understand the role of controlling elements and their influences and contribution (Law 2006).

Framing

Framing is an operation that can help to define actors and distinguish different actors and goods from each other (Callon 1999). This last and final stage in the ANT process can help a network to stabilise. At this stage, key issues and debates would

already have been negotiated within the network, and technologies can become more stabilised over time (Wickramasinghe and Bali 2009).

14.6 The Actor-Network Theory Approach to Evaluate HIS

To fully comprehend the successful development, implementation and use of a new technology known as the HIS in health care, it is important to investigate beyond the linear models of technology adoption, diffusion and transfer. Simple binary models are not enough because of the complex and dynamic nature of healthcare settings. The complex nature of interaction between the technology and social often renders the two inseparable (Williams-Jones and Graham 2003).

ANT is considered an appropriate choice to analyse the HIS evaluation study because it can be used to identify and acknowledge the impacts of human and non-human, social or policy issues within the healthcare setting (Latour 2005). ANT is robust enough to accurately capture the complexities, nuances and richness of healthcare operations. In doing so, ANT can also be used to investigate and theorise questions about why and how networks come into existence, what sort of associations and impacts they can have on each other, how positions move and change in a network, how actors enrol and leave the network and most importantly how networks can achieve stability (Callon 1999; Doolin and Lowe 2002; McLean and Hassard 2004). An assumption of ANT theory is that if any new actor is enrolled or an old actor leaves a network it affects the whole network (Cresswell et al. 2010; Doolin and Lowe 2002).

The ability of actors and end users to contest the problematisation of the technology can be affected by power structures already present in the network. These considerations are naturally relevant to the context of the HIS implementation and adoption in complex healthcare settings.

Any translation may succeed or fail, but only when failures of technology and networks occur then one will be able to reveal the underlying reasons and embedded norms and values (Greenhalgh and Stones 2010; Law and Hassard 1999; Williams-Jones and Graham 2003). In an ANT context, translation that has not properly incorporated the differences in social (nurse's perceptions, requirements and needs) and technology/system offerings has led to these issues arising. However, without ANT it is also easy to dismiss the user perspective as "they just do not get it", which happens frequently in the implementation of information systems into healthcare contexts (Greenhalgh and Stones 2010).

Actor-network theory is considered an appropriate choice for HIS implementation and adoption because it can identify and then acknowledge all human and non-human actors within the healthcare setting and any impact of their interaction on social or policy issues that might occur (Latour et al. 1996).

In doing so, ANT can also help to investigate the question of why and how networks come into existence, what sort of associations and impact they can have on each other, how they move and change their position in a network, how they enrol

and leave the network and most importantly how these networks can achieve stability (Doolin and Lowe 2002; Callon 1986; McLean and Hassard 2004) that would lead to successful implementation and adoption of proposed system. ANT's assumption that if any new actor is enrolled in the network or old actor leaves the network, it would affect the whole network (Cresswell et al. 2010; Doolin and Lowe 2002) will help us to understand the impact of the HIS on underlying structures of healthcare settings.

ANT can also assist in understanding the active role of objects in shaping social realities by challenging the assumption of the separation between non-human and human worlds (Greenhalgh and Stones 2010; McLean and Hassard 2004; Rydin 2010; Tobler 2008; Walsham 1997). This would assist researchers in studying the complexities of the relationships between human and non-human actors, the sustainability of power relationships between human actors and what kind of influence artefacts can have on human actors' relationships in transforming health care (Cresswell et al. 2010).

The rational to choose ANT to evaluate the HIS system is the strength of ANT's ability to identify and explore the real complexities involved in healthcare service delivery. Other approaches used to study information systems adoption, such as diffusion of innovation (DOI) theory, emphasise the properties of the technology or individual and organisation itself in isolation without considering the rules of their interaction. This approach can oversimplify the very complex nature of healthcare service delivery setting (Wickramasinghe and Bali 2009), whereas ANT's approach of investigation can cover these complexities by thoroughly studying the network of actors and their associations. Thus, ANT can provide a unique way to view HIS implementation and adoption studies.

14.7 Critique and Limitations of ANT

Although ANT has been applied to the implementation and adoption of many IT-based healthcare innovation studies (Berg et al. 2003; Cresswell et al. 2010, 2011; Hall et al. 2010), it is important to note that ANT has also been criticised for its limitations (Williams 2007; Cresswell et al. 2010, 2011; Greenhalgh and Stones 2010; Walsham 1997). Some of the key limitations of ANT identified in the literature include a lack of ability to consider the broader social structures (Walsham 1997) and a lack of ability to consider the macro-environmental factors (McLean and Hassard 2004). However, the advocates of ANT have argued that the macro level structures of the system or society are made up of the same artefacts so they can be analysed in the same way as micro level structures. Further the advocates of ANT have argued that ANT is flexible enough to allow different levels of analysis. Latour (2005) argues that differences between network and actor are two faces of the same phenomenon. Mixing structuration theory with ANT can help in overcoming this problem as it can link multiple levels of analysis from individual to organisation level settings (Walsham 1997).

Another criticism of ANT is its inability to explain the formation of relationships between actors and over changes of events in networks (Cresswell et al. 2011; Greenhalgh and Stones 2010; Kaghan and Bowker 2001). ANT's assumption of symmetry between the social and technological actors has also been criticised (Mutch 2002). There is an argument that all actors are not same as some can have more influence than others and human feelings and emotions can play strong role in different circumstances (Mutch 2002; Walsham 1997).

Another criticism of ANT relates to its methodological standing. It has been argued that ANT is a method of describing rather than explaining (Bloomfield 1991); however, Latour (2005) counters this criticism by explaining that ANT does not try to explain the actor's reasons for joining the network but searches for procedural activities that happen in negotiations between different actors. Thus, ANT never intended to explain the behaviour, but ANT is a way to understand why and how the actors behave (Law and Hassard 1999).

Lastly, the position of the researcher in the research is another criticism of ANT. The researcher's role in labelling actors, defining the passage point and scoping the actor network can be influential and can have an impact on the results. Thus the researcher should be critical in their labelling of actors and analysis in general and thereby be guided by the actors themselves.

To overcome these limitations, many researchers have suggested that ANT can be combined with other theoretical lenses such as structuration theory (ST) and strong structuration theory (SST) (Cresswell et al. 2011; Greenhalgh and Stones 2010; Trudel 2010; Walsham 1997).

14.8 Conclusion

The need for IT-based interventions in the healthcare service delivery to improve information and communication and thereby provide superior value-based care is well recognised globally. Different e-health solutions are being implemented with mixed success to address this challenge (Protti and Smit 2006; Basch 2005; DesRoches et al. 2008; Greenhalgh and Stones 2010). It is, therefore, important to evaluate these technologies with theoretically informed approaches to enjoy more successful outcomes.

We believe it is important to develop a deeper understanding constraint to the development, adoption, implementation and diffusion of these various HIS solutions. Specifically, we suggest that a sociotechnical, e.g. ANT-based, approach can inform and facilitate such evaluations.

A sociotechnical approach of study will allow more flexibility in system design and adoption. We have argued that this approach will be of benefit to both practitioners for better design and implementation and researchers for better evaluation. One of the main challenges of technology-based organisational change research is to find the answer of an ontological question of balance between agency and structures (McPhee and Poole 2001; Tobler 2008). This chapter has served to outline the key

concepts of ANT that are relevant in the context of the HIS adoption and implementation and discussed the appropriateness of an ANT-based theoretical lens for the evaluation of HIS in very complex environment of healthcare service delivery. We have also noted that ANT has been criticised by several scholars because of its appropriateness as an ontology and/or epistemology (Latour 2005). Therefore, we recommend that to reduce the negative impact of these limitations, the use of structuration theory can be incorporated.

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