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EDITORIAL – From the Editor-in-Chief

As the new Editor-in-Chief appointed to overlook the 11th issue of iSCHANNEL, I am pleased to see such diversity of topics, opinions and commentaries published this year. Contributing to a student research journal such as iSCHANNEL, be it as an editor, reviewer or author, is a worthy challenge for any MSc or PhD student. In fact, I have myself contributed to the journal as a writer and reviewer while a MSc student, and I am doing so now as the editor, pursuing my PhD in Information Systems.

Reflecting on my past year in the role of editor, I can certainly admit that it has been a challenging but rewarding experience. An editor, as I have learned, is responsible for managing the whole editorial process. That means that apart from reaching out and encouraging authors to submit their articles, the editor assigns articles to reviewers and, together with them, makes decisions regarding the articles' publication.

Besides developing your management and organisation skills, this exercise also gives you a privileged view into the editorial process of research journals in academia. The iSCHANNEL review process relies on double-blind peer review. Authors receive comments from reviewers and are given a chance to introduce improvements. The reviewers' activity not only bears the quality of the articles published, but also helps them improve their own work through engaging in peer review. Essential in academia, peer review has benefits for both parties.

Writers contribute to iSCHANNEL by replying to the call for papers going out in spring. In my own experience, I can certainly say that submitting an article to the journal helps in developing your own essay writing skills. Through the process of review and the opportunity to receive peer feedback, you become a better writer. Moreover, you have the opportunity to see your work published and hone your research skills.

In my view, iSCHANNEL plays a vital role within the MISDI and PhD in Information Systems community. I'm looking forward to heading it as the Editor-in-Chief with the indispensable help from fellow students.

Marta Stelmaszak

PhD Candidate in Information Systems and Innovation

EDITORIAL – From the Faculty Editor

This year's ISChannel arrives with, as usual, a huge range of interesting and relevant topics.

I very much hope that these will spur others to write for the journal in the future: whether you are MSc students, PhD students or Alumni. We do not impose copyright on articles written so if you wish to develop your article further for other publications that is welcomed rather than discouraged (though a small acknowledgement would be appreciated).

I will now provide a brief taster of the articles included in this edition:

Adeela Afzal is critical of techno-rational approaches to e-government, highlighting the need to consider more socially and politically embedded perspectives alongside these assumptions. In concluding the paper Adeela writes "the technical rational perspective generalises and attempts to predict future development, which can compromise its legitimacy, while concepts within the socially embedded reasoning describe abstract notions that often require contextual interpretation." – something I hope policy makers will heed.

Bjoern Christian Wolf raises a contemporary and hugely important debate around decentralised mechanisms of cryptographic technologies termed "darknet markets" (e.g. the "Silk Road"). The article highlights many important issues and discusses the various types of technology such as Tor in detail. Crucially he highlights how these technologies have led to alternative institutions separated from traditional legal and government power.

Adam Balwant provides a critical literature review concerning managing IT process innovation. This review will prove useful to many of our students as they wrestle with the complexities of IT process innovation via CSF, situated change and strategic management via the RBV. And if the last sentence is confusing you – well you had just better read the article!

Florian Allwein looks at much more fundamental issues of our field of Information Systems – the very nature of information itself. Whereas the word "information" is everywhere few consider the varied conceptualisations of this term and how these have consequences – particularly in a world of copious digitally mediated data.

In change to the usual ISChannel format we have included two articles with a more journalistic style. The first by Antti Lyyra introduces "Watson" – IBM's famous Artificial Intelligence product. Given the increasing significance of AI in contemporary IT debates this article is a welcome introduction to Watson's opportunities and limitations.

The second is an article, first published on an LSE blog, and written by PhD student Ayesha Khannah (co-authored by myself) introduces a research project into Digital Infrastructures for Mobility as a service. This article nicely showcases the kinds of research being carried out by PhD students within the department of management.

To end my editorial I wanted to thank our editor-in-chief Marta Stelmaszak who has worked tirelessly to put this issue together. Her dedication is valued. I would also like to thank the authors, reviewers and associate editor Priyanka Pandey who all worked hard to put this issue together.

Dr. Will Venters

Faculty Editor

Opinion: Exploring Watson

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Introduction

Watson is IBM's digital poster boy for the future of Exploring Watson

Watson is IBM's digital poster boy for the future of computing, named after IBM's first CEO Thomas J. Watson. It entered the limelight by winning the quiz show Jeopardy! in 2011. Since the victory, Watson has been heralded in numerous newspaper articles, books and journal papers for its potential.

IBM is investing heavily in Watson to establish it as a platform for what they call cognitive computation. In the section of IBM's website that is dedicated to Watson, the anchor text urges to "Go beyond artificial intelligence with Watson". The further description of Watson on the page implies something that is akin to John H., aka Dr. Watson who made his mark as Sherlock Holmes's brilliant assistant. In no uncertain terms, Watson is said to be "a cognitive technology that can think like a human", a tall order. In the video of IBM Watson personalisation, Watson speaks in first person and says, among other things, that "I am helping Sesame Street make education unique to every child". Let us take a closer look at what Watson is and how it has evolved over the past ten years.

Watson the Jeopardy! player

The idea of a Jeopardy! playing computer program was first floated in 2004 when IBM was looking for suitable challenges to push boundaries. The first test were run in 2006 and in 2007 the project was granted a team of 15 people and three to five years to prepare for the competition. The team was tasked to engineer a computer that integrated various existing technologies and principles of natural language processing and machine learning, and to train it appropriately with a big set of data.

Jeopardy! is a quiz show in which the host reads out, in natural language, a general knowledge cue in the form of answer whereas the answer is given as a question. If a contestant is confident of knowing the answer, he or she hits a buzzer. The fastest buzzer answers first, and if the answer is wrong, the turn is given to the second and then to the third fastest. Below is a question, which Watson answered correctly in the competition.

Question:

> *An assassin fired 2 shots into William McKinley at the 1901 Pan-American exposition in this city*

Answer:

> *What is Buffalo?*

IBM contacted the producers of Jeopardy! In 2008 regarding the challenge. During the preparation, several matters had to be dealt with. For example, whereas human contestants received cues as speech, the ninety servers that fed the Watson screen on stage received them as text. Also, IBM researchers insisted to have the questions selected in a way that would not exploit Watson's logical deficiencies while the Jeopardy! producers required that Watson will have to press the physical button like the other contestants did. Such were the tensions that the competition was almost cancelled.

Seven years after the initial idea was floated, in 2011, the highly engineered special purpose computer program that was running on sophisticated hardware, took on the Jeopardy! champions of the day and came out as a winner. While Watson was a one-trick pony, the name Watson reached a household status overnight and secured its place in IBM's product and marketing portfolio. The IBM Journal of Research and Development published an extended special issue in 2012 to describe Watson as it existed at the time of competition.

Watson as a service provisioning platform

Although IBM was highly successful in creating the Jeopardy! Watson, Watson did not perform well in other tasks. Therefore, IBM decided against a product based strategy in commercialisation. Currently, IBM makes Watson available in a piecemeal manner by providing cloud-based services to process and analyse unstructured data, that is, some aspects of texts and conversation, audio and images. IBM has named the services as Language, Speech and Vision. Application developers can use and combine these services in various ways to design and develop Watson applications that serve a particular purpose.

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The services are provisioned through application programming interfaces (APIs). APIs are like service counters: bring a document to a service counter you think is fit for job and ask a specific question regarding the document you brought with you. After that, the document will be taken to the back room for processing and in no time the results are handed back to you. The prices of API queries vary as per the API and volume of use. As an example, a single conversation API query costs $0.0025 with a standard plan.

Currently, Watson is most skilled in text processing. Eight API service sets are made available to process text. The API set called AlchemyLanguage offers analysis services to extract sentiment, keywords, entities, and high-level concepts from texts among other things. The conversation API provides basic blocks to build a dialog model for a chat bot. The Natural Language Classifier API classifies and categorises short texts (max 1000 words) but its pre-trained classification scheme may need fine-tuning and training with a labelled data set to make it more suitable for a specific use case. Other text APIs include Document Conversion, Language translator, Retrieve and Rank, Tone Analyser and Personality Insights.

The text processing APIs are supported with the audio and image APIs. For audio, there are two APIs: to translate speech to text and text to speech, and to provide audio based input and output for text processing services. For images, there is only one API available and it analyses images and returns keywords to describe the content of images. Similarly to the Natural Language Classifier API, its pre-trained model may need additional training depending on the use case. In addition, there are APIs for the latest news and decision making support, named as AlchemyData News and Tradeoff Analytics.

IBM, after ProgrammableWeb, labels this sort of APIs as PhD APIs, "a class of APIs that packs the power of a team of doctoral students and researchers". Also, a PhD in a relevant field might be needed to understand, interpret and discriminate between the models, services and answers they provide.

Given that Watson APIs are designed and built to process unstructured data in the form of text, supported by APIS that can translate between speech and text and convert images to categories and keywords, IBM provides other sets of tools to process structured data, databases and numbers. These tools can be combined with Watson APIs.

Watson in purposeful applications

As developing a Watson application is about integrating APIs together, let us have a look at some of the applications developers have created.

In 2015, IBM and TED teamed up to bring APIs and content together to build watson.ted.com (requires login). There, one can type in a question, insert a Twitter handle or give a piece of text (100-2000 words) as an input and then get back a list of TED videos that appear to answer a person's question or reflect the Twitter profile or a piece of text. Please do give it a try to see if your questions are answered.

Recently, e3, a digital agency, listed the five coolest ways to use Watson. The number one was to light up a dress at Met Gala. The Ted Watson described above held the second place, while talking to children through toys made it to the third. The fourth on the list was Under Armour's fitness app that utilises Watson, whereas the personality analysis based on the Twitter feed was left fifth.

To speed up the exploration on how to monetise Watson and increase the number of much needed Watson developers, IBM has launched innovation competitions. For example, IBM and Innovate UK run the Intelligent Data Insights contest that awarded six teams with £35000. Also, cash rewards are available for skilled and inventive chatbot developers in the first Watson Developer Conference in San Francisco in November 2016. Softbank and IBM have partnered to bring Watson APIs to the Pepper robot platform.

In a forward looking manner, IBM has already set its eyes on the next grand challenge. IBM launched with XPrize a five million dollar and four year competition called IBM Watson AI XPRIZE to develop artificially intelligent applications. The competition milestones are in 2017, 2018 and 2019, while the grand finale takes place at the TED 2020. If the past predicts the future, the awesomeness will be Watson in spirit if not strictly in a subsequent application.

Watson means Watson

Based on the above, Watson is not a singular entity. The Jeopardy! playing Watson is a quiz game winner, engineered painstakingly over multiple years to win a competition that was played under strict rules and constraints. That was achieved by bringing together various text processing methods in a way that suited playing the game of Jeopardy!. Later on, to monetise the effort, Watson was broken down back to its constitutive elements and made available in the form of Watson APIs. Consequently, developers and users combine and fine-tune the APIs to develop applications that serve particular purposes, since it is extremely difficult to build computerised behaviours that generalise across contexts; if potential buyers want the artificially intelligent behaviour shown on telly but tailored to their needs, they should design and build it themselves while IBM provides tools, building blocks and advice. Moreover, in the future, IBM Watson AI XPRIZE challenge may grab more varied skills and meanings under the Watson umbrella.

To avoid confusion and misunderstandings that may arise when a single word is used to describe many potentially overlapping matters, it would be beneficial to develop and use more fine-grained and descriptive language when discussing the platforms and applications that provide and make use of computational natural language processing in some of its various forms.

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http://www.ibm.com/watson/

IBM Watson on Personalization:

https://www.youtube.com/watch?v=Ag12vSmvu8I

Watson (computer):

https://en.wikipedia.org/wiki/Watson_(computer)

Miles vs. Watson: The Complete Man Against Machine Showdown:

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Watson Recommends:

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Watson Developer Conference:

http://www.ibm.com/watson/developer-conference/

IBM Watson AI XPRICE competition:

http://ai.xprize.org/about/overview

IBM Watson to Power SoftBank Robotics' Pepper:

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E-Government Development and Organizational Structures

A Critical Review of Technical Rational and Socially Embedded Perspectives

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KEYWORDS

E-Government
ICT
Organisational forms
Political values

ABSTRACT

As organizations continue to apply IT in order to provide more accessible and convenient digital services, citizens expect the same level of accessibility from government services. As a result, governments are increasingly participating in the "e-government movement". However, there is a debate regarding how to successfully implement this concept and authors present different theoretical perspectives regarding how governments can move towards a "fully functional electronic government". This critical review presents and compares these perspectives. Technical rational perspectives provide stepwise guidelines for how governments can develop their structures to better accommodate e-government and alter their organizational forms accordingly. In contrast, socially and politically embedded perspectives emphasise gradual change, take contextual aspects into consideration and see IT as a means to enforce and sustain political and social values. This review seeks to outline the core assumptions within these perspectives and evaluate the supporting arguments and empirical evidences to assess their strength and suitability.

Introduction

The significance of information technology and digital innovation within organizations has accelerated rapidly in the last few decades. This trend results in higher expectations towards the availability of electronic services provided through the internet and web-based technology (Margetts and Dunleavy, 2012). Digital services are perceived as more convenient (Layne and Lee, 2001) as opposed to traditional paper-based procedures or face-to-face interactions. As people have access to digital services through private firms, they expect public services to offer digital alternatives as well. It is therefore difficult for governments not to take part in the "e-government movement" (Layne and Lee, 2001).

Despite recent initiatives, Layne and Lee (2001) suggest that most governments have not successfully implemented a fully functional electronic government. Moreover, research shows that 85% of e-government project fail (Cordella, 2007). As a result, there is an ongoing academic debate regarding the causes and possible solutions for this. Scholars present different perspectives regarding e-government development: technical rational theories, that believe government practices need to be altered to favour e-government and accordingly provide guidelines; and socially and politically embedded perspectives, that consider the institutional context and see the use of IT as a means to enforce and sustain political values. This review looks at literature within these perspectives in order to evaluate strengths and weaknesses in the core assumptions and supporting arguments.

To better evaluate the literature, we need to clarify how to define the term "e-government". Layne and Lee define e-government as the use of technology to enhance service delivery and information assimilation. Other authors further enrich this description by acknowledging the strategic value (Andersen and Henriksen, 2006), organizational setting (Cordella and Tempini, 2015) and the institutional forces (Luna-Reyes and Gil-Garcia, 2014; Cordella and Iannacci, 2010) involved in the introduction of ICT to the public sector. Taking these views into consideration, this paper defines e-government as the use of ICT to increase both efficiency and effectiveness in public sector organisations.

The paper is organised as follows: The next section provides a brief description of e-government. This is followed by a review of the assumptions and arguments within the technical rational perspective, including the guidelines and organizational forms that this perspective suggests for moving towards e-government. In this context the focus is on the managerial rationality. Moving further, the next section introduces the politically and socially embedded perspective and evaluates the theoretical assumptions and evidences in a similar manner. Because of the nature of the topic, this section mainly focuses on the political aspects within this

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perspective. Finally, the conclusion presents the most evident strengths and weaknesses of the two sets of perspectives and suggests future use.

1. Technical Rational Perspective

A series of authors present theoretical models that describe development stages to help realize the "ideal" state of e-government, through planned action and predefined guidelines (Klievink and Janssen, 2009; Andersen and Henriksen, 2006; Layne and Lee, 2001). Some authors further present alternative organizational structures to better accommodate this IT-enabled organizational change, and realize the full potential of e-government (Klievink and Janssen, 2009; Andersen and Henriksen, 2006; Reddick, 2004; Layne and Lee, 2001). This section discusses these technical rational perspectives in order to evaluate their underlying assumptions.

1.1 Development – Maturity Models

The literature describes best practices and models to provide guidelines for evolving towards e-government. These are termed as "maturity models", where the level of maturity relates to the institution's ability to engage in e-government (Andersen and Henriksen, 2006). Despite proposing a variety of models, they share the common aim of a stepwise restructuring of public institutions (Klievink and Janssen, 2009; Andersen and Henriksen, 2006; Layne and Lee, 2001). Some widely recognised models are Layne and Lee's four stage model (2001) and the Public Sector Process Rebuilding Model (PPR) (Andersen and Henriksen, 2006).

Layne and Lee's model consists of four "Stages of Growth" (2001). The various stages are: cataloguing, making information available online; transaction, moving towards two-way interactions; vertical integration, across different government levels; and horizontal integration, across different functions. The PPR model differs from this in that it claims to consider customers (citizens) and organizational activities to a larger extent (Andersen and Henriksen, 2006).

An underlying assumption in regard to these models is that the development of e-government requires strategic planning and will result in major changes, to the extent that the government service itself will be redefined (Andersen and Henriksen, 2006; Layne and Lee, 2001). This assumption is reasoned by comparing the development with the way e-commerce has altered the private sector (Layne and Lee, 2001). Accordingly, the assumption seems to be based on the belief that a technology-driven change in the public sector will unfold similarly to that of the private sector. However, the literature does not make it evident whether a similar approach is suitable for e-government. A valid point made by Cordella (2007) in this regard is that this cannot be taken for granted as public and private sector organisations serve different purposes. Specifically, the reference to citizens as customers is widely criticised as is does not account for the distinct relation between citizens and the government, as opposed to the relation between a consumer and a private supplier.

Another core assumption made in these models is that e-government is an evolutionary phenomenon that requires stepwise development (Klievink and Janssen, 2009; Layne and Lee, 2001). For instance, Layne and Lee (2001) present linear stages that describe the necessary steps in this evolution towards the vertical and horizontal integration of government services. This aspect highlights two assumptions: firstly, that governments may only be classified within the defined stages; secondly, that each step is directly dependant on the completion of its predecessor.

In this regard, some authors attempt to justify this stage-wise classification of e-government development, and the practical applicability of these stages. Reddik (2004) presents findings from e-government practices in New Zealand, that show that most governments initially aim for an online presence. Similar research from practices in the US and Spain reveal the availability of one-way information as most common. Accordingly, this can be assumed as the first step. Moreover, findings from the US show modest movements towards two-way interaction with citizens, which indicates that this could be the next step governments naturally move towards. However, most governments are still in these early stages (Andersen and Henriksen, 2006; Reddick, 2004; Layne and Lee, 2001) and there is a lack of evidence to validate the subsequent steps. Additionally, the current state of governments, as presented in empirical evidences, does not give specific indications about future movements and how feasible a vertical and horizontal integration is.

Based on these findings, it seems that although maturity models provide useful guidance, empirical evidence suggests a possible design reality gap, which makes the descriptions of future stages mere predictions, normative models with a lack of evidence.

Furthermore, these models characterise the main factor for success and the ideal situation as the availability of efficient, digital, vertically and horizontally integrated government services (Andersen and Henriksen, 2006; Layne and Lee, 2001). It is argued that this will provide more accessible information and digital services, thereby reaching customers more efficiently (Andersen and Henriksen, 2006; Layne and Lee, 2001). A valid point made in this regard is that citizen acceptance will grow as users will have a single-point of contact (Klievink and Janssen, 2009; Andersen and Henriksen, 2006; Layne and Lee, 2001). However, this suggests that the success of e-government initiatives is only measured in terms of efficiency, not effectiveness. As a result, there seems to be an unjustified lack of discussion on the effectiveness of public services. Also, there is little mention of political compatibility towards horizontal and vertical integration and any challenges that could result from this.

Moreover, other aspects related to user acceptance, such as universal access, privacy and trustworthiness are not evident in the suggested final stage of the ideal e-government state. Layne and Lee (2001) acknowledge some of these aspects, however their proposed model does not incorporate them.

Finally, the literature does not seem to describe how generic these models are and whether they are suitable for all types of governments and government relations. Based on empirical findings, Reddick (2004) suggests that the expected progress is most evident in the government to business relationships (G2B), not in relation to citizens (G2C). This indicates that the models are perhaps more suitable for certain aspects of e-government.

1.2 Organizational Forms

Theories within the managerial rationality discuss organizational forms and governance structures to increase efficiency and in this way take advantage of the full potential of IT (Greve, 2015; Margetts and Dunleavy, 2014; O'Reilly and Reed, 2010; Dunleavy, 2005). Two of the organizational forms that authors discuss are New Public Management (NPM) and Digital Era Governance (DEG).

NPM is a dominant managerial practice from recent times (Greve, 2015; Margetts and Dunleavy, 2014; Dunleavy, 2005; Heeks, 1999). This has been described as a decentralized organizational structure that aims to reinvent the government administration by considering citizens as customers in a market-oriented setting, and introducing concepts such as competition to increase efficiency (Margetts and Dunleavy, 2014; Cordella 2007). There is also an emphasis on the role of technology in the process of reorganization. Some authors explain that NPM came as a reaction to the perceived weaknesses of the bureaucratic structure (Cordella, 2007; Heeks, 1999). However, it is argued that NPM was not as revolutionary as expected, and has even resulted in negative effects (Greve, 2015; Margetts and Dunleavy, 2014; Cordella, 2007; Dunleavy, 2005). In response, Dunleavy (2005) proposes digital-era-governance (DEG) as the successor of NPM.

The main concepts of DEG include reintegration, holism and digitalization (Dunleavy, 2005). Through reintegration it proposes to rollback parts of the decentralization of NPM (Dunleavy, 2005). The reintegration and holism concepts also complement the idea of vertical and horizontal integration suggested by the maturity models (Dunleavy, 2005; Andersen and Henriksen, 2006). Additionally, DEG emphasises managerial change revolving around IT, and it is argued that this will increase efficiency and improve the service level (Margetts and Dunleavy, 2014; Dunleavy, 2005). They further expect the second wave of DEG to introduce disruptive changes.

A common aspect of these ideas is the underlying concept of managerialism: "the belief that all aspects of organizational life can and should be managed according to rational structures" (Wallace and Pocklington, 2002, p.68, cited by O'Reilly and Reed, 2010, p.962). These structures reflect the aim of increased efficiency and productivity as a result of IT-based managerial change, justified by the belief of managerialism (O'Reilly and Reed, 2010). Moreover, these concepts support the underlying assumption that there is a need to reorganize in accordance with digital changes, towards more rational modes, to take advantage of the full potential of IT (Greve, 2015; Margetts and Dunleavy, 2014; Dunleavy, 2005).

It seems that this assumption is driven by the perception that the full potential of e-government cannot be realized through the inefficient hierarchal form, as this is not suitable for adapting to the digital change (Greve, 2015; O'Reilly and Reed, 2010; Cordella, 2007). This criticism identifies inefficiencies within the complex tiers created by hierarchal forms (Dunleavy, 2005). However, there seems to be a lack of justification for why these shortcomings are presumed to be directly related to bureaucracy. In this regard, Cordella (2007) suggests that any inefficiencies related to bureaucratic forms are a result of increased complexity, and suggests improving the structure, instead of altering its nature. Also, the fact that DEG aims to rollback some of the changes of NPM's disaggregation (Dunleavy, 2005) indicates that the once perceived required change might not have been necessary. Moreover, structures proposed after NPM are mainly evolved through the identified shortcomings of NPM. This indicates that organizational practices have an experimental nature, and raises the question of whether the new proposed forms will result in the predicted way.

Furthermore, an assumption in regard to NPM is that concepts from the private sector can be adopted in the public sector (Dunleavy, 2005). For example, automating processes to increase efficiency, emphasising the importance of performance management (O'Reilly and Reed, 2010). However, similarly to technical rational theories for development, the reviewed literature does not seem to consider the different nature of public services (as opposed to private), and it is not clear whether these concepts are suitable for e-government. For instance, factors such as universal access and service reliability are identified as more critical for public services (Dunleavy 2005; Layne and Lee, 2001) than for private companies. DEG's concept of digitalization and a full digital mode (Dunleavy, 2005) overlooks the possibility of citizens without access and could therefore be in conflict with the concept of universal access.

2. Reflective Reasoning

As opposed to technical rational theories, the socially embedded perspective considers the broader institutional context and organizational practices, and proposes an incremental approach to development. Building on this notion, the literature within this perspective further describes organizational forms where the focus is towards public institutions' function as a political entity to enhance democratic values through e-government (Navarra and Cornford, 2012; Cordella, 2007).

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2.1 Development – Institutional and Social Factors

In contrast to technical rational perspectives, socio-technical theories do not provide specific guidelines and models for development. Instead they present the development of e-government as a continuous and incremental process (Luna-Reyes and Gil-Garcia, 2014; Norris and Reddik, 2013; Cordella and Iannacci, 2010; Bretschneider, 2003), taking into consideration the wider social context. However, it is also acknowledged that this gradual change towards e-government adoption can eventually result in radical changes (Norris and Reddik, 2013).

The primary assumption within this perspective is that e-government projects cannot be planned according to technical rational stage-wise models due to complex interactions between institutional factors, political arrangements, organizational structures and the technology involved (Luna-Reyes and Gil-Garcia, 2014; Cordella and Iannacci, 2010; Cordella, 2007; Bretschneider, 2003). Cordella and Iannacci (2010) argue that there is a need to focus on this intrinsic complexity, instead of following generic best practices.

Some authors further argue that this complex and dynamic nature of e-government can result in unanticipated changes, which is why an incremental process that allows improvements is more suitable (Luna-Reyes and Gil-Garcia, 2014; Norris and Reddik, 2013; Cordella and Iannacci, 2010). It is explained that this will also allow continuous evaluation and thereby assist in further development (Luna-Reyes and Gil-Garcia, 2014). Norris and Reddick (2013) sustain this assumption with empirical evidence from US governments, where their findings indicate that the predicted stage-wise development was not observed, having instead been adopted an incremental type of development. Moreover, a case study by Luna-Reyes and Gil-Garcia (2014) illustrates how continuous change and improvement in a project for development of a government portal resulted in a positive outcome.

This empirical evidence partially validates aspects of socially embedded reasoning. This approach, however, is also criticised for its abstract nature. Moreover, it has been stated that the outcome depends on contextual factors (Luna-Reyes and Gil-Garcia, 2014; Cordella and Iannacci, 2010), the success of one or two of these projects might not be a proper indicator of the validity of this approach.

Another assumption within this perspective is that the development process involves a two-way interaction and mutual shaping between technology and institutional and organizational settings (Luna-Reyes and Gil-Garcia, 2014; Cordella and Iannacci, 2010). It has been argued that this two-way interaction affects the implementation and perception of IT and the outcome of e-government development projects (Luna-Reyes and Gil-Garcia, 2014; Cordella and Iannacci, 2010). Cordella and Iannacci (2010) sustain this assumption and illustrate this reciprocal shaping through a case study of an e-government project in England and Wales, where the system was affected by the environment and vice-versa.

The examples and case studies the reviewed literature describes validate the presented theories. Moreover, the literature illustrates a broader view by introducing institutional aspects. However, this view also does not seem to focus much on citizens' role in the development process.

2.2 Organizational Forms – Reflecting Political Values

The literature within this perspective also discusses organisational structures for e-government. It is primarily emphasised that alterations in organizational forms need to consider the underlying values of the established structures (Navarra and Cornford, 2012; Cordella, 2007). Moreover, some authors highlight the importance of taking into consideration institutional aspects, as the value of technology depends on how it is put into practice (Cordella and Tempini, 2015). In this regard IT is described as a means to enforce political values. One such example is Cordella's proposed e-bureaucratic form which, he argues, enforces democratic values (2007).

The e-bureaucratic form is described as the use of technology to deliver services to achieve the main objectives of public institutions, such as enforcing democratic values of equality and fairness (Cordella, 2007). It is argued that although bureaucratic organizations have been criticised, they have succeeded in enforcing these values (Cordella and Tempini, 2015; Cordella, 2007). In this manner, the emphasis is not on bureaucracy as an organizational form, but on the democratic values it conveys. Cordella (2007) further states that any perceived inefficiencies in bureaucratic organizations are not due to the hierarchical structure, but the increased complexity from information overload.

Navarra and Cornford similarly present alternatives to the NPM managerial model. They introduce: "consultative models", which emphasise transparency and user involvement"; "participatory models", using IT to increase citizen involvement and democratic representation; and "disciplinary models", IT use to acknowledge the importance of e-government beyond goals of increased efficiency.

A primary assumption these organisational concepts reflect is that, as opposed to technical rational ideologies, the potential of IT is perceived to be more political than administrative (Navarra and Cornford, 2012). Some authors suggest that technology can be a "carrier" of political aims, and that e-government ICTs accordingly hold political properties (Cordella and Tempini, 2015; Navarra and Cornford, 2012; Ahn and Bretschneider, 2011; Cordella and Iannacci, 2010; Cordella, 2007). Moreover, these properties can be utilised to enforce democratic values, improve control, enhance transparency and increase citizen engagement (Navarra and Cornford, 2012; Ahn and Bretschneider, 2011; Cordella, 2007). Navarra and Cornford (2012) sustain these arguments through examples of successful cases that have adopted these e-government models.

This assumption of the nature of e-government is contrasted against managerial ideas. It is argued that political properties are embedded in the existing forms and managerial theories underestimate the effects new structures will have on the underlying logic of the public administration, its function and e-government's potential to serve wider political purposes (Navarra and Cornford, 2012; Cordella, 2007). For instance, it is argued that, by introducing a market-like structure, NPM would differentiate between citizens and be in conflict with fundamental democratic values (Cordella and Tempini, 2015; Navarra and Cornford, 2012; Cordella, 2007). To sustain this argument, a logical reasoning is presented of how hierarchal structures enforce democratic values and how the introduction of market-like structures could challenge these values (Navarra and Cornford, 2012; Cordella, 2007).

Although these arguments are logically sound, there is little evidence that illustrates democracy being challenged as a result of novel managerial practices. For example, although some authors discuss unsuccessful implementations of NPM (Cordella, 2007; Dunleavy, 2004), the success is often measured towards goals related to efficiency and productivity. There is little evidence suggesting that this is due to the effects NPM has on the underlying democratic values.

Conclusion

In conclusion, the theories presented in this paper describe alternative conceptualizations of how scholars suggest to develop e-government and organizational forms for the digital age. While technical rational theories provide useful guidance towards adoption of ICT in the public sector, socially embedded perspectives educate us in the underlying complexities and political factors that are involved in the underlying processes. In this manner, both sets of theories provide useful insights towards these aspects of e-government, and can be used alongside each other in order to get a broader view of the macro- and micro-processes involved. However, it is equally important to be aware of the weaknesses of these perspectives. As the paper highlights, the technical rational perspective generalises and attempts to predict future development, which can compromise its legitimacy, while concepts within the socially embedded reasoning describe abstract notions that often require contextual interpretation.

The focus of this review was mainly directed towards managerial and political aspects. Accordingly, perspectives related to user acceptance and the role of citizens in the development of e-government was not explored in detail, and may be subject to further research.

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Integrating digital systems to help city residents plan seamless journeys

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Introduction

The 21st century has seen a growing recognition of the importance of cities in the world: not only does over half[1] of humanity live in cities, but cities contribute 60 per cent[2] of global GDP, consume 75 per cent[3] of the world's resources and generate 75 per cent[4] of its carbon emissions. There is little doubt that the enlarging footprint of cities, with the rapid rate of urbanization in the developing world, will be where "the battle for sustainability will be won or lost"[5] and, for those engaged in "smart-cities" initiatives, the focus of winning this battle is through the use of digital technology to efficiently manage resources. One of the key sectors for such smart cities initiatives is transportation.

Transportation infrastructures today rely heavily on private car ownership, which is powered by fossil fuels, and public transportation, both of which operate independently of each other. Policy makers believe radical innovation in this sector is needed to move it to a more sustainable system of mobility.

To achieve the goal of sustainable, seamless, and efficient mobility, an infrastructure would be required that would allow residents to move away from private ownership to a combination of car-sharing and public transport. For example, such an intermodal chain of mobility might include taking a rented bicycle to the bus station, a bus to a stop near the office, and then a car-sharing service to the office, covering every step from the point of origin to the last mile. Powered by renewable energy, electric vehicles could make this journey entirely green.

In order to create such a mobility infrastructure, all the services offered (buses, trains, car-sharing systems, charging stations, and payments) would have to be integrated using digital technology in order to provide an urban resident with an easy way to map and take an intermodal journey using her smartphone. This change would transform transportation as we know it today to Mobility-as-a-Service[6] but requires considerable innovation in the various heterogeneous digital computer-based systems (what we might term the information infrastructures), underpinning the physical transportation infrastructure. (For a more detailed account of the ideas of information infrastructure see Hanseth, O. and E. Monteiro, 1998)[7]

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Framing an Academic Project

Academic research on how such mobility information infrastructures would grow from the constituent disparate systems that currently exist in silos has been nascent, especially on the topic of the coordination efforts required. Part of the reason is that many required elements of such infrastructures do not currently exist, and that cities are only just beginning to prototype them.

In our research, we use a theory of digital infrastructure coordination[8] as a framework to unravel the forces that influence the development of a mobility focused information infrastructure, extending it to focus particularly on the influence of temporal rhythms within the coordination. Understanding this has important implications for policy makers seeking to better support smart-cities initiatives. Our research took us to Berlin and a project which was prototyping an integrated sustainable mobility system there.

The BeMobility Case Study

The BeMobility project[9], which lasted from September 2009 to March 2014, was started as part of a concerted effort by the German government to become a market leader and innovator in electric mobility. A public-private partnership between the government and over 30 private and academic sector stakeholders, the goal of BeMobility was to prototype an integrated mobility services infrastructure that would be efficient, sustainable and seamless for Berlin residents. The largest railways operator Deutsche Bahn was chosen as the lead partner of the project, with the think-do tank InnoZ (an institute focused on future mobility research) as the project coordinator and intermediary. Organizations participating in the project ranged from energy providers like Vattenfall[10] through car manufacturers such as Daimler[11] to technical scientists provided by Technical University of Berlin[12].

The project, despite facing many challenges, was able to prototype a transportation infrastructure which integrated electric car sharing with Berlin's existing public transport system. In the second phase of the project, it further integrated this infrastructure with a micro-smart power-grid, providing insights into how such mobility services could be powered by renewable energies. While the integration effort was both at the hardware and software levels, our research studied the coordination efforts related to information infrastructure in particular.

"Integration of all this information is what we now call Mobility-as-a-Service. BeMobility was one of the first projects in the world to attempt to do it." - Member of BeMobility Project

Findings and Discussion

Our analysis showed that individuals and organizations respond to coordination efforts based on a combination of historical cycles of funding, product development and market structures, and anticipated patterns of technology disruption, innovation plans and consumer behaviour. Peoples' actions in contributing to an integrated infrastructure are tempered not only by these past and future rhythms, but also by the limits of the technologies they encounter. Some of these limitations are physical in nature, such as the inability to integrate data due to lack of specific computing interfaces, and some are political, such as blocked access to databases due to concerns about competitive espionage and customer privacy.

Our findings also surfaced the power of the intermediary as coordinator. Contrary to the limited perception of a coordinator as a project manager and accountant for a government funded project, we saw InnoZ emerge as a key driver of the information infrastructure integration. One of the most powerful tools for the intermediary was its role in mapping future rhythms of technology development. It achieved this by showcasing prototypes of different types of electric vehicles, charging stations, solar panels, and software systems, at InnoZ's campus.

This campus itself acted as a mini-prototype where both hardware and software integration could be first implemented and tested. The ability to physically demonstrate how the micro-smart grid could connect with the car-sharing system to enable sustainable energy for electric cars, for example, both surprised and motivated other stakeholders to take the imminent possibility of a sustainable mobility infrastructure more seriously.

Ultimately, business stakeholders were especially concerned about the commercial viability of such radical innovation. Here too the intermediary proactively shaped their thinking by conducting its own extensive social science research on the behavioural patterns of current and future users. For example, by showing that young urban residents were more interested in car-sharing than private ownership of cars, InnoZ made a strong case for why an integrated infrastructure could also be a good business investment.

Implications

As more cities experiment with Mobility-as-a-Service, understanding the influence of rhythms on coordinating information infrastructure is helpful for policymakers. Insights that would be useful to policymakers include:

- Keeping a budget for building an innovation lab where cutting edge technologies can be tested and integration efforts can be showcased will lead to more engagement with stakeholders.

- Working more closely with the intermediary to conduct social research on the mobility habits of millennial urban dwellers will incentivise stakeholders as it will prove a market for the smart infrastructure.

- Anticipating the disciplinary inertia imposed by legacy systems and organizational practices, and countering it by including stakeholders in the working group whose temporal rhythms include innovative product cycles more in line with the goals of the integrated infrastructure.

This study also contributes to the academic literature on information infrastructure development by providing insights on the role of time in coordinating integration efforts. It responds to a gap in the understanding of the evolution of large-scale multi-organizational infrastructures, specifically as they relate to mobility.

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Managing IT Process Innovation Within Organizations

A Critical Literature Review

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KEYWORDS

IT Process innovation
Critical success factor
Situated change
Resource-based view

ABSTRACT

This review explores the recent literature on managing IT process innovation within organizations. From the various studies in this field, we examine three main approaches to managing IT process innovation - critical success factors (CSF), situated change, and strategic management via the resource based view (RBV) of the firm. The CSF approach emphasizes the importance of management support, team structure, network competence, and culture within IT process innovation. However, the CSF approach ignores the concept of emergent change within the IT process, and this is where the situated change approach is more useful. The situated change approach challenges the traditional CSF approach by showing the importance of incremental and frequent change within the IT process. Finally, the strategic management approach illustrates how innovation is managed through the RBV of the firm. The RBV of the firm proposes that organizations should develop their IS resources into strategic assets and capabilities to gain a competitive edge from the IT process.

Introduction

Innovation is a concept that describes how organizations acquire new technological capabilities and explore new business processes (Murat Ar and Baki, 2011). There are two main types of innovation: product and process. On the one hand, product innovation has an external focus on customers who will purchase and use the product. On the other hand, process innovation typically has an internal focus in which the customer is senior management, who seeks to improve the process in order to increase the efficiency of the organization (Bender et. al, 2000). There are several benefits that organizations derive from innovation.

Innovation plays a vital role on the economic performance of businesses because it facilitates rapid expansion, higher profit margins, and a competitive edge (Kleinknecht et. al, 2003). However, not all businesses that attempt to innovate are successful in the process. For instance, within process innovation, 90% of all early Enterprise Resource Planning (ERP) projects were either delayed or over their initial budget (Plant and Willcocks, 2007). Therefore, even though IT process innovation provides economic benefits for businesses, the evidence shows that this type of innovation must be managed carefully to ensure that these benefits are realized in time and within budget.

There are several different approaches that can be adopted by organizations to manage IT process innovation. Some of the common approaches include: an examination of the critical success factors (CSF), social construction of technology, strategic management via RBVF, institutional approach, and situated change approach. While each of these approaches are useful for managing new IT process innovation, I have opted to focus on only three of these approaches: CSF, situated change, and strategic management. I chose these approaches as they are more prominently featured in new innovation literature, as compared to SCOT and the institutional approach. This review juxtaposes these unique approaches.

First, the CSF approach describes a range of success factors that is critical for managing IT process innovation. The CSF approach was the traditional model used in early literature to describe successful implementation of IT processes. The most common success factors examined in the literature are top management support, team structure, network competence, and organizational culture (Soja, 2006; Bender et. al, 2000). The CSF approach is discussed in more detail in Section 1 of this review.

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Second, the situated change approach describes the social construction of IT process innovation from a socially embedded perspective. While the CSF approach states success factors that must be implemented at a point in time, the situated change approach illustrates how innovation is rather a continuous process. The interaction with new IT processes change over time due to ongoing learning of the actors involved (Igira, 2008). Section 2 focuses on how such change is managed in IT process innovation through the concept of improvisation and ongoing learning.

Third, the strategic management approach describes process innovation management from a technical rational perspective where the resource-based view (RBV) of the firm is utilized. The RBV of the firm proposes that firms utilize their IS resources and capabilities such as knowledge management and collaboration in order to manage new IT processes (Tarafdar and Gordon, 2007). Section 3 describes the strategic management approach in more detail. At the end of this review, I develop a conclusion on the different approaches explored in the literature, and offer further implications for future research based on the limitations discovered.

1. Critical Success Factors of Managing IT Process Innovation

The CSF approach describes how organizations achieve success by implementing a set of factors that past experiences have shown to be important for success (Karin et. al, 2011). The concept of success factors was developed in early literature by Ronald Daniel in the 1960s. From this concept, Rockart (1978) derived the CSF approach, which is still used in practice today within many IT studies. For instance, in some recent studies, authors use the CSF approach to show how ERP systems can be successfully implemented. Bender et. al (2000) argue that as long as project managers are able to facilitate the following critical success factors, they will differentiate themselves through increasing rates of IT process innovation.

1.1. Management Support

Management support refers to the involvement of high level managers in the implementation duties of the IT process (Soja, 2006). Support from top level management is one of the most important of all the critical success factors of IT process innovation (Plant and Willcocks, 2007; Soja, 2006). Without proper management support in the IT process, employees may follow a wrong direction which can result in a defective process (Blindenbach-Driessen et. al, 2006). In giving support, managers must ensure that the process is aligned with the strategic goals of the organization (Kuang et. al, 2001). Furthermore, managers should be fully committed and willing to dedicate resources to the implementation of the process.

Management support also comprises of setting appropriate schedules and deadlines. As Bender et. al (2000) argue, deadlines should be set aggressively to encourage a faster work pace in the organization. However, deadlines should not be unrealistic as this can lead to reduced morale of the employees and thus inefficiencies (Bender et. al, 2000). Bender et. al (2000) make the assumption that employees working at a faster pace does not compromise the quality of their performance, and thus the IT process.

In addition to scheduling, the vision of top management is also important to facilitate IT process innovation. Managers must be aware of the goals, labour required, process limitations, and the capital investment that is essential for the IT process (Soja, 2006). The goals must be detailed in order to ensure that the scope and plan of the process are well understood by all users involved (Soja, 2006). Additionally, the goals must be clearly stated and comprehensible so as to communicate with the employees involved in the process. Such communication improves the visibility and awareness of the IT process innovation within the organization (Blindenbach-Driessen et. al, 2006).

1.2. Team Structure

Teams should include a variety of highly skilled and knowledgeable workers (Soja, 2006). In addition, it is beneficial to have a mixture of skills and experience within the team from both internal and external sources. In his study of ERP success factors, Kuang et. al (2001) argue that organizations should utilize cross functional teams that include the best people from internal staff and external consultants. Blindenbach-Driessen et. al (2006) reinforce this view by adding that cross functional teams are beneficial because they enhance collaboration and improve results due to a better understanding of the process.

Blindenback-Driessen et. al (2006) make the assumption that cross functional teams are able to work together and implement the new process in an efficient manner. However, within cross functional teams, there may be circumstances of disagreements and conflicts which may lead to the disruption of the new IT process. Nonetheless, cross functional teams can create a competitive advantage for organizations by creating a resource that is difficult to imitate (vis-à-vis RBV), e.g., a highly cohesive team built on trust (Karimi et. al, 2007). This will be discussed further in Section 3.

Management Support for the new IT process	
Kuang et. al (2001) Soija (2006) Bender et. al (2000)	• Managers must ensure process is aligned with strategic goals. • Goals must be detailed and clearly communicated to improve visibility and awareness of IT process. • Deadlines and schedules should be set aggressively but not unrealistic.
Team formation of both internal and external sources	
Soja (2006) Blindenbach-Driessen et. al (2006)	• Teams should include a variety of highly skilled and knowledgeable workers. • Cross functional teams enhance collaboration and improve results.
Network competence to obtain useful resources	
Ritter and Gemunder (2003)	• Social interactions with firms allow access to critical resources which are useful for the innovation process.
Culture that links employees' relations with the organization	
Kuang et. al (2001)	• Firms should promote a culture with shared values and common goals.

Table 1. Success factors of managing IT process innovation

1.3. Network Competence

Network competence is the ability of a company to manage their technological network in order to perform tasks while also managing the skills and knowledge needed to perform these tasks (Ritter and Gemunden, 2003). A company's network competence is positively correlated with process innovation success (Ritter and Gemunden, 2004). Network competence is important because social interactions and managerial skills are required for successful completion of the IT process. (Ritter and Gemunder, 2003). Social interactions with other organizations provide firms with access to critical resources which can enhance their knowledge and skills regarding the innovation process (Ritter and Gemunden, 2004). These resources may include skilled personnel (e.g. consultants), larger facilities, and quality information on the new process.

1.4. Culture

Organizational culture describes the shared meanings and expectations held by different members of a group (Igira, 2008). An organizational culture should not be viewed as an obstacle to implementing an IT process, but rather as an important concept that is linked to the socio-economic aspects of employees' relations within the organization (Igira, 2008). Kuang et. al (2001) extend this view by stating the importance of promoting a culture with shared values and common goals in order to achieve IT process innovation success. The underlying assumption here is that the culture of the organization can be easily implemented to suit the new process. However, it is more likely that a new culture emerges as users adapt to the new IT process and make sense of it (Kostopoulos et. al, 2002). This concept of emergent culture will be discussed in Section 2 where we analyse the importance of situated change in managing process innovation.

2. A Situated Change Approach to Managing IT Process Innovation

The situated change approach is developed from a socially embedded reasoning, and this approach demonstrates how the IT process is socially constructed. Socially constructed processes are subjected to different interpretations that are compatible with various relevant groups (Howcroft et. al, 2004). For example, when implementing a new ERP process, it is likely that different users will have different reactions to the process as it evolves over time (Sunmer, 2006).

While the CSF approach of managing process innovation is useful, it may not be the most comprehensive of the three approaches. In order to implement success factors, organizations act in a planned way, which contrasts with the view of the situated change approach. The idea of success is vague and a simple implementation of success factors may not always be sufficient. Additionally, much of the literature that adopts the CSF approach is dated. Within recent studies, there have been more complete perspectives for understanding process innovation management, such as the situated change approach.

As a process, the situated change approach to innovation management consists of emergence, development, and implementation of ideas that are spread across organizations (Garud et. al, 2013). Larsen and Bogers (2014) question whether innovation is a result of practices as opposed to ideas, because such practices are prone to changes over time due to the concepts of improvisation and ongoing learning (Igira, 2008). These changes are incremental and continuous and are impacted by both internal and external factors. Furthermore, such emergent changes challenge the traditional CSF approach because these changes illustrate a different approach to managerial involvement, team structure, and culture.

2.1. Managerial Involvement

Improvisation allows managers to adapt to changes and improve their products and services in a continuous and creative manner (Vera and Crossan, 2005). Contrary to the CSF approach, IT process innovation is sometimes implemented without a predetermined strategy and without the initial support of top management (Essen and Lindblad, 2013). Instead, the IT process is often a matter of managers and employees improvising and learning throughout. Larsen and Bogers (2014) describes process innovation as a paradox where managers are in charge of the process but not in control of the improvisational aspect. Nonetheless, once the process is in place, managers must be aware of and participate in the improvisation within the implementation of an IT process innovation (Larsen and Bogers, 2014).

Improvisation is dynamic because ideas emerge in a nonlinear fashion (Larsen and Bogers, 2014). As a result, a 'shadow' often unfolds within the implementation of new IT processes (Larsen and Bogers, 2014). These 'shadows' are informal conversations between employees that arise in the innovation process. These informal conversations assist in understanding the negotiations of the process. Managers should include these shadow themes because they can lead to creative potential and important ideas for improving the process (Larsen and Bogers, 2014). However, the task of filtering out unimportant informal conversations may be difficult and time consuming for managers.

2.2. Team Structure

Teams improvise when they adjust and make sense of new IT processes. Vera and Crossan (2005) introduce the idea of collective improvisation where they assume that improvisation is a skill that can be learned by team members. Collective improvisation within the IT process is influenced by the expertise of the team members, the degree of trust, and the level of communication (Vera and Crossan, 2005). Vera and Crossan (2005) assume that organizations should train teams to develop an understanding of what improvisation is. However, teams are more likely to participate in an ongoing learning process as opposed to improvising based on any formal training procedure.

2.3. Culture

While the CSF approach assumes that a culture can be implemented to suit the process, the situated change approach highlights that culture emerges as users adapt to the process. The situated change approach indicates that managers should embrace a culture that facilitates experimentation, controlled risk and continuous learning (Vera and Crossan, 2005). In dealing with the uncertainty of new IT processes, employees continuously learn new activities and skills that are used to alter the process and improve efficiency (Igira, 2008). Kostopoulos et. al (2002) extend this point by stating that this process of ongoing learning has a positive effect on innovation because it helps the firm to generate new knowledge, develop existing skills, and adapt to the changing nature of the environment. Continuous learning is also critical for the 'sense and response' approach to ongoing learning (Kostopoulos et. al, 2002). The sense and response approach to ongoing learning indicates that the organization makes sense of the changes in the process and reallocates its resources to employ a suitable response (Kostopoulos et. al 2002).

3. Strategic Management of IT Process Innovation: A Resource-Based View (RBV) Perspective

In theory, the RBV of the firm explains how firms are able to develop and sustain a competitive advantage by utilizing their resources (Kostopoulos et. al, 2002). While the situated changed approach is developed from social embedded reasoning, the strategic management approach arises from the technical rationality perspective. The CSF approach and situated change approach are both beneficial, but they fail to account for the significance of the resource-based view (RBV) of the firm in managing IT process innovation.

A firm's individual IS resources should not be isolated but rather looked at as a collective and supplementary

Managers are in charge but not in control of the IT process	
Larsen and Bogers (2014)	• IT process is often a matter of managers and employees improvising and learning throughout. • Informal conversations often arise in the process and it is important for managers to accommodate such conversations as they can lead to creative potential and new ideas.
Teams improvise as they adjust and make sense of IT process	
Vera and Crossan (2005)	• Collective improvisation is influenced by the expertise of team members, the degree of trust, and level of communication.
Culture changes and adapts to the IT process	
Vera and Crossan (2005)	• Managers should embrace a culture that facilitates experimentation, controlled risk and continuous learning. • In dealing with the new IT process, employees continuously learn new activities and skills that are used to alter the process and improve efficiency.
Igira (2008)	

Table 2. Situated change approach to managing IT process innovation

benefit (Karimi et. al, 2007). Firms must develop these resources into strategic assets and capabilities which are valuable, rare, and difficult to imitate (Wade and Hulland, 2004). Within IT process innovation, there has been a shift in focus from tangible assets to intangible assets. These intangible strategic assets impact process innovation by promoting knowledge sharing, organizational learning, and relationship building (Hervas-Oliver et. al, 2014).

3.1. Knowledge Management

Knowledge management allows employees to obtain knowledge about the new IT process and to access and spread this knowledge within the organization (Tarafdar and Gordon, 2007). Organizations should focus on developing a knowledge management competency in order to better manage IT process innovation because the process is knowledge intensive (Tarafdar and Gordon, 2007).

In addition to creating a competency based on internal knowledge, it is important for organizations to obtain knowledge from external sources. External sources such as interaction and community building are critical to managing a new IT process (Sorensen and Lundh-Snis, 2001). According to Hervas-Oliver et. al (2014), some organizations rely on the external community to compensate for weak in-house capabilities. These organizations need to integrate external information from previous research, as well as the expertise of other external sources such as consultants (Tarafdar and Gordon, 2007).

In summary, organizations should utilize a combination of internal and external sources of knowledge to develop a unique capability that is difficult to imitate. However, there are two underlying assumptions here that can weaken this argument. Firstly, some organizations may have strong in-house capabilities and may not require external advice on the new process innovation. Secondly, employees may find it difficult to immediately utilize the knowledge obtained because the new IT innovation may be a process of ongoing learning.

3.2. Collaboration and Communication

In addition to building a strong knowledge management competency, organizations should develop a competency in collaboration and communication to better manage the IT innovation process. This competency allows the users involved to complement each other's efforts by disseminating knowledge and suggesting new ideas or solutions to the process (Tarafdar and Gordon, 2007). Furthermore, this competency can lead to the development of unique relationship resources within the organization.

3.3. Relationship Resources

A relationship resource is built on the level of trust that is developed among the employees within a team through their history of interactions (Karimi et. al, 2007). Trust among team members is necessary for employees to agree on the various operations involved in the implementation of the new IT process. Additionally, trust can be an extremely rare competency which is difficult to imitate because it takes years of working together to develop (Karimi et. al, 2007). This trust competency in the strategic management approach contrasts the CSF approach because trust goes beyond the basic idea of team

Develop a knowledge competence as IT processes are knowledge intensive	
Hervas-Oliver et. al (2014)	• Some organizations rely on external sources (community, research, and consultants) to compensate for weak in-house capabilities.
Communication facilitates a smooth implementation of IT process	
Tarafdar and Gordon (2007)	• Users complement each other's efforts by disseminating knowledge and suggesting new ideas for the IT process.
Relationship resource built on trust between team members	
Karimi et. al (2007)	• Trust among team members is important for employees to agree on the different operations involved in the implementation of the new IT process. • Trust can be a rare competence that is difficult to imitate as it takes years of working together to develop.

Table 3. Strategic management of IT process innovation

structure. The strategic management approach identifies that organizations must build on the relationships of team members to gain a competitive advantage (Karimi et. al, 2007), rather than simply composing a team of the best people (Kuang et. al, 2001).

Conclusion

The three approaches identified in this review are all important to managing IT process innovation. The CSF approach identifies a variety of key success factors that organizations should implement in order to successfully introduce a new IT process innovation. Some of these factors include management support, team formation, network structure, and culture. While this approach is useful, it is highly outdated and it fails to account for the emerging change that occurs when implementing these factors.

To compensate for the shortcoming of the CSF approach, the situated change approach is utilized to illustrate the importance of incremental change and ongoing learning within the IT process (Igira, 2008). For instance, Larsen and Bogers (2014) illustrate how a new IT process is often a of matter managers improvising and learning throughout. In addition to managers, teams also improvise as they adjust and make sense of the new IT innovation. Finally, an organizational culture changes as it adapts to the cultural habits of the new IT process.

The strategic management approach illustrates how firms are able to better manage the IT process by developing strategic assets and unique capabilities (Kostopoulos et. al, 2002). For example, Hervas-Oliver et. al (2014) highlights that firms must focus on developing a knowledge competence as IT processes are usually knowledge intensive. The strategic management approach also emphasizes the importance of building a relationships resource based on a high degree of trust between team members.

Overall, firms may find it useful to draw from all three approaches to manage IT process innovation. Although the CSF approach may be dated, it can still be useful for managers to utilize CSF if they are able to integrate these factors with a situated change approach. For example, as an ERP process evolves over time, organizations should alter the role of managers and the structure of the team (Sunmer, 2006). In addition, managers should also develop their IS resources (i.e., knowledge, collaboration, and relationship building) in order to gain a competitive edge.

The literature examined in this review is not without limitations. First, most of the studies focus on evaluating one IT process (e.g., ERP) within one organization or a select few organizations. Future research can evaluate the implementation of a variety of IT processes across a larger number of firms in order to better generalize the findings. Second, most of the studies look at a limited number of factors and competencies which limits the scope of the research. In order to overcome this, more thorough studies should be conducted with a wider range of factors that are also updated to suit the IT changes that have occurred over the years. Third, the relationship between success factors, competencies and IT process innovation is context-specific and will be different depending on the organization or industry (Tarafdar and Gordon, 2007). Further research should compare the differences between organizational settings and sectors. Finally, future research is needed on the best practices for consolidating the links between (a) success factors and IT process innovation and (b) competencies and IT process innovation.

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Research Commentary: Data as Facts of the World

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KEYWORDS

Data
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Knowledge
Raw Data
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ABSTRACT

Information Systems research so far has not come up with a clear conceptualization of the central term of 'information'. A similar claim can be made about the term 'data', which is used inconsistently, but often taken to mean raw information. The field would benefit from clear definitions that distinguish these terms from each other. This paper argues for seeing data as facts of the world and information as data stored and processed in information systems. It aligns this with the ontology of critical realism and outlines how this view can guide future research. Information systems are seen as efforts to capture the facts of the world from the domain of the actual and store them in the domain of the empirical in order to make them accessible for analysis. This view is especially useful in the context of big data research, but also helps to justify why explanatory research in the social science tradition is still essential.

Introduction

As the field of Information Systems (IS) research is trying to develop original theories (Grover & Lyytinen 2015), there is surprising ambiguity over some of its key terms. For example, the field has not yet come up with a clear conceptualization of the central term 'information' (McKinney & Yoos 2010). A similar claim can be made about the term 'data', which is used inconsistently, but often taken to mean raw information. This is unfortunate as the term has become more widely used in IS research recently, especially due to the phenomenon of "big data" (Mayer-Schönberger & Cukier 2013; Constantiou & Kallinikos 2014; Goes 2014). This paper argues that the field would benefit from clear definitions that distinguish these terms from each other. It discusses the use of the terms 'information' and 'data' in the IS literature before proposing an alternative view that sees data as facts of the world and information as data stored and processed in information systems. It aligns this with the ontology of critical realism and outlines how this view can guide future research.

Conceptualizing data and information

As McKinney & Yoos (2010) show, "'Information' is poorly defined in the Information Systems research literature, and is almost always unspecified, a reflexive, all-purpose but indiscriminant solution to an unbounded variety of problems." (p. 329). They present four views of information, the most common being the token view, in which information "is synonymous with data: both refer to tokens manipulated by processes" (p. 331). It is interesting to note that even in a popular book on Big Data, the authors use the term 'information' to define data, as Mayer-Schönberger & Cukier (2013) define big data as "[t]he ability of society to harness *information* in novel ways to produce useful insights or goods and services of significant value" (p.2, my italics).

As the field of IS research is increasingly concerned with data, a clear definition of this term would be desirable. Looking at some basic definitions for these terms, we find marked differences: The Oxford English Dictionary defines data as "symbols on which operations are performed by a computer" and information as "that which is obtained by the processing of data". On the other hand, in a typical introductory IS textbook, Laudon (2014) defines data as "[s]treams of raw facts" (p. 609) and information as "[d]ata that have been shaped into a form that is meaningful and useful to human beings" (p. 612).

Recent IS papers on data apply definitions like "data as the measurement or description of states" (Kettinger & Li 2010, p.409) or "[d]ata is the underlying resource for [business intelligence]" (Lycett 2013, p.381). Kettinger & Li (2010) make an explicit attempt to conceptualize the terms. Motivated by concerns about the conceptual foundations of the field, they discuss different views on information. They acknowledge that the "'data --> information --> knowledge' hierarchy is very popular in the IS field" (p. 409), but point out that a "completely satisfying solution in defining these concepts and their relationship allowing for consistent and generalized use" (p. 409 f.) has not been found. They find that "[d]ata (…) have been generally defined as the measure or description of objects or events" (p.

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411) and "[i]nformation is usually defined as data processed into a form that has meaning to the user" (p. 412). Thus we see that there is a common notion of information being generated out of data. Data is generally seen as abstract quantities or characters. This is also reflected in a recent book on the data revolution: "Data are commonly understood to be the raw material produced by abstracting the world into categories, measures and other representational forms – numbers, characters, symbols, images, sounds, electromagnetic waves, bits – that constitute the building blocks from which information and knowledge are created" (Kitchin 2014, p.1). Overall, two main views of data can be distinguished:

- Data as raw information – this is the view shared by the OED, in Laudon's textbook and many recent information systems papers on data (e.g. Aaltonen & Tempini 2014; Constantiou & Kallinikos 2014).

- Data as synonymous to information – this is what (McKinney & Yoos 2010) call the "token view" of information.

A different view is proposed by Agarwal & Dhar (2014, p.444), who argue that "economic and social transactions are moving online, allowing for the digital capture of big data", which seems to imply that data exists outside the digital.

In summary, we see that there is significant disagreement in the IS field on what the two central terms of 'information' and 'data' mean and how they are distinguished. Moreover, this paper argues that the views outlined here are not sufficient. The token view appears unsatisfying as there is no reason to use these central terms interchangeably, or synonymously. The "raw information" view is more convincing and has been applied in much relevant research. However, it leaves central questions unanswered, e.g. how exactly data is distinguished from information. Would a raw stream of structured data classify as information? How about a confusing display of data from a database on an old ERP system? Is it structured enough to be called information?

A different view

This paper proposes a different view that was initially inspired by a website dedicated to "surviving and thriving in the age of information overload" (Ingebrigtsen 2016). This is how it is outlined there:

> Data is/are the facts of the World. For example, take yourself. You may be 5ft tall, have brown hair and blue eyes. All of this is "data". You have brown hair whether this is written down somewhere or not.
>
> In many ways, data can be thought of as a description of the World. We can perceive this data with our senses, and then the brain can process this. (…)
>
> Information allows us to expand our knowledge beyond the range of our senses. We can capture data in information, then move it about so that other people can access it at different times.

This can be related to the notion of data existing outside the digital, as formulated by Agarwal & Dhar (2014). Moreover, a similar idea has been developed earlier by Checkland & Holwell (1998):

> there is a distinction to be made between the great mass of facts and the sub-set of them which we select for attention, those to which we pay heed. The obvious word for the mass of [f]acts is 'data' (p. 89).

Consequently, it is argued here that data should be seen as facts of the world – which also fits the literal translation of the Latin data, 'that which is given'. Whereas Checkland & Holwell coin the term "capta" for the sub-set of data that is captured, this paper argues for calling them "information". This means that we should talk about information (rather than data) stored and processed in information systems.

The benefit of this view is that it distinguishes data from information both conceptually and epistemologically. Data is seen as something that exists in the world, whereas information is processed data (as in the "raw information" view outlined above). This is interesting as it seems to relate to the ontology of critical realism (e.g. Mingers 2004; Wynn & Williams 2012), especially the stratified view of reality as the domains of the real, the actual and the empirical. The real contains generative mechanisms but cannot be observed. The actual contains all events that occur, while the empirical contains the subset of the actual that is observed. Thus, it is argued that events in the domain of the actual usually create a data trail and that information systems are created to capture this data, turn it into information (in the domain of the empirical) and manage and manipulate this information.

Discussion

As the literature review has shown, the view proposed here contrasts with the views commonly held in Information Systems literature. Yet it has some distinct advantages that make it worth considering. First of all, it would solve the dilemma of the token view of information – the fact that the central terms of 'information' and 'data' are used interchangeably. Given the centrality of these terms for the field, it seems important to come up with definitions that clearly distinguish between them, and to use them consistently. Lee (2010) shows how the token view of information is "indispensable to IS practice" (p. 344) and "foundational to the other views" (p. 344 f.). He nevertheless argues that researchers should adopt other views more often. Either way, they should make an effort to define how they use these terms, e.g. using the typology by McKinney & Yoos (2010) as a starting point.

Critical realism has been increasingly taken up in IS research (e.g. Bygstad 2010; Henfridsson & Bygstad 2013; Zachariadis et al. 2013). Thus, the view of data as facts of the world presents an opportunity to strengthen the conceptual basis of IS research on data and information while at the same time aligning to this growing ontological tradition. Indeed, the parallels of this view to critical realism are interesting. In such a view, the appeal of "big data" technologies would be that they extend the scope of the domain of the empirical – as more and more data can be captured from the domain of the actual, big data tools turn this into accessible and useful information. This would apply to e.g. management information systems capturing real-time production data and turning it into information to present in a dashboard, but also for the "quantified self" movement, where individuals gain insight into their habits, e.g. by counting their daily steps (data) and storing them as information in web-based information systems in order to analyse and share it.

Information systems can thus be seen as efforts to capture "the facts of the world" from the domain of the actual and store them in the domain of the empirical in order to make them accessible for analysis. This also points to a reason why we still need social sciences and qualitative methods even in a world of big data: as the domain of the real cannot be directly observed, big data based approaches have no access to it either. The only way to research generative mechanisms in the domain of the real remains to hypothesize them and research their explanatory potential, e.g. using the method of retroduction as described by various researchers (e.g. Bygstad & Munkvold 2011; Volkoff & Strong 2013).

Given the on-going debate on the identity crisis in Information Systems research (Baskerville & Myers 2002; Benbasat & Zmud 2003; Grover & Lyytinen 2015), it appears the field would benefit from more variety in research and a distinctive profile based on its own theories. Coming up with a set of clear concepts is an important step in this direction. It is hoped that this paper will encourage a discussion along these lines.

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Decentral, unbreakable and anonymous?

Literature Review of resiliency mechanisms in darknet markets

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ABSTRACT

This article identifies socio-technical mechanisms of darknet markets that render them resilient to law enforcement based on relevant literature. In depth, it analyses the interplay between user or community behaviour and cryptographic technology. The four main activities of darknet markets that are necessary for successful coordination are identified as: (1) transaction and communication, (2) trust and reputation, (3) payment and (4) logistics, each addressed through a combination of ICTs and community norms. The marketplaces act as intermediaries facilitating an anonymous, decentralised market by joining these four areas and offering a resilient solution.

Introduction

After the advent (and demise) of Silk Road, the first online market for drugs and other illegal goods, darknet marketplaces or cryptomarkets have become a fixed component of modern drug trade. In order to understand the mechanisms that make them successful and render law enforcement agencies (LEAs) relatively powerless, an analysis of the technologies employed and their interplay with the user behaviour and community culture of these darknet markets is in order. Simply pointing to cryptography is myopic and technologically deterministic, since it ignores the texture and specific environment it is embedded in. Instead, analysing socio-technical factors will yield more relevant results.

The paper begins by defining the core terms and definitions of darknet, deep web and dark web as used here, since the usage of these terms varies in the literature. Afterwards, darknet markets and their properties will be introduced through a literature review. Based on the various fields covered by the literature, the four fundamental market activities that darknet markets have to cover in order to operate successfully will be identified and analysed: 1. Transaction and communication, 2. Trust and reputation, 3. Payment and 4. Logistics, followed by a short discussion and conclusion.

Darknet, deep web or dark web?

Before diving into the analysis, the terminology of darknet markets needs some clarification, since there are multiple areas of research with slightly different research objects. The most ubiquitous, yet often misunderstood term is the darknet. Other terms are the deep web and the dark web.

By darknet, this paper refers to the encrypted overlay network of the internet, which is not publicly accessible (Mansfield-Devine, 2009). Instead, special clients like Tor have to be employed to facilitate a successful connection (Flick & Sandvik, 2013). However, this is a description of the type of connection and not the content found there.

On this technical overlay of the internet there exists an alternative to the openly accessible web, the so-called dark web. The dark web is often contrasted with the 'surface web', the part of the web that exists on the unencrypted internet (Bergman, 2001). Due to the nature of the darknet (which hosts the dark web), indexing individual pages and making them accessible to search engines is not possible (Rudesill, Caverlee & Sui, 2015). The entirety of all non-indexed pages in the internet is the so-called 'deep web' (Halevy & Madhaven, 2009). Besides the entire dark web, it also includes pages that cannot be indexed for other reasons. The content of social media pages is often only accessible from specific profile pages and intranets or otherwise protected content also belongs to the collection, making the deep web multitudes bigger than the dark web, and by some accounts even the entire visible internet (He et al, 2007).

Darknet-based research focuses on several phenomena. One of the earliest areas of darknet research focuses on peer-to-peer - or more specifically friend-to friend - file sharing networks like Napster or Pirate Bay with an emphasis on avoiding DRM (Wood, 2009; Acquisti, 2004). While file sharing is theoretically also possible in the dark web, the Tor infrastructure has low bandwidth and blocks traffic from file sharing (Tor FAQs, 2016), limiting it to the realm of P2P.

Another area of darknet research is focused on botnets, internet worms, and denial of services (DDoS) attacks, originating from unused address space, also called network telescopes or blackhole monitors (Bailey et al, 2006).

However, a current stream of research addresses phenomena on the dark web, focusing on areas ranging from religious and political extremism and terrorism in the darknet (Chen et al, 2008; L'huillier et al, 2010) through the specific technological infrastructure (Li et al, 2013) to a large amount of research on darknet markets, as detailed below.

This paper sets out to review the literature that concern these markets, with a focus on the socio-technical methods employed to guarantee their functionality.

Darknet markets

In a very similar fashion to Amazon, Ebay and other internet markets that digitised commerce to a great degree, darknet markets are digitising illegal black markets, for products ranging from false passports through stolen credit card information to small-scale firearms and other weapons. The biggest share of activity, however, is the digital drug market they created.

Like the entire dark web, darknet markets can only be accessed through means of encryption, like Tor or i2p. This reduces the possibility of tracing the location of vendors, buyers or marketplace operators and administrators to a great degree. A brief insight into the technical sight will follow later. All trades are settled in cryptocurrencies, with Bitcoin being the most popular one.

The size of dark markets is methodologically hard to measure, since market participants are anonymous, no taxes are paid and no accounting figures published. However, in the legal process against the founder of the first established darknet market Silk Road, the total turnover over the course of three years has been quantified as $1.2 billion (Barratt, Ferris & Winstock, 2014), while other researchers suggest a lower estimate of $22 million turnover per year (Phelps & Watt, 2014). At first sight, this seems almost negligible in the face of the annual global drugs trade that amounts to around $435 billion, as established by the United Nations Office on Drugs and Crime and Europol (UNODC, 2013).

However, for several reasons it is worth to investigate further. Most scholars agree that size and market share of illegal drug markets will keep increasing (Hardy & Norgaard, 2015), with some even projecting 'exponential growth' for hidden drug markets (Buxton & Bingham, 2015). The reasons for this are manifold. Efficiency gains of the darknet market have led to lower financial transaction costs (Brito & Castillo, 2013), improve transparency and quality of the drugs sold (Bancroft & Reid, 2015) and lower the prices through fierce competition (Martin, 2014), enabled by the global visibility of previously local drug distributors (Hardy & Norgaard, 2015).

Another difference is the type of users. It has been shown that the average user of darknet markets is younger and more likely to be male than the average drug user (Van Buskirk et al, 2016). In addition, the technical complexity and lack of violent aspects that often accompany and highly stigmatise street purchases of drugs lead to an appeal to a different target group of technically literate. On the side of the marketplace operators, advanced technical skills are necessary, and the motivations range from profit-orientation to idealist, often techno-libertarian convictions that all trades should be legal and possible (Bearman & Hanuka, 2015).

However, one of the central reasons for the sustained growth of darknet markets is the socio-technical infrastructure and culture of the darknet markets that renders identification of vendors and buyers very hard. The remainder of the paper analyses how darknet markets address various challenges posed by LEAs.

The core activities of dark markets

Unlike conventional online marketplaces, darknet markets offer almost entirely illegal products. This means, that in addition to the activities any online marketplace has to undertake, darknet markets need to operate under the scrutiny of LEAs.

This makes the entire operating procedure much harder, since each step has to be secure enough to withstand the scrutiny of LEAs. The purchase on darknet marketplaces can be broken down into four distinct activities. The current situation is a result of iterative learning of the entire community. New weaknesses were exposed after each market was taken down, since the evidence obtained had to be published in court. As a result, the current solutions are robust enough to allow functioning markets.

The activities cover the different phases and associated problems of each transaction and the resulting socio-technical solution.

- Activity 1: Transaction and communication

  How can seller and buyer interact anonymously without LEAs interfering?

- Activity 2: Trust and reputation

  How can the buyer trust the product arrives and is of adequate quality? How can the seller ensure the buyer pays?

- Activity 3: Payment

  How do darknet market participants avoid the money trail leading to their capture?

- Activity 4: Logistics: How can the products be delivered anonymously, even if either of the agents is a LEA?

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1. Transaction and communication

An inherent difficulty of illegal drug markets is given by the very premise of the transaction. In order to obtain t he product, the buyer has to know the seller and communicate interest in a product. The seller communicates price and availability of the desired product. This precedes any possible transaction and this information facilitates the market. Without a knowledge of products and prices available, no transaction will happen.

Since the knowledge of the seller (or the facilitator of the trade, in cases of big platforms) is a requirement for most real world drug transactions, this has been a primary angle for LEAs, posing as interested parties and observing the typical transaction spots.

1.a Tor infrastructure

Darknet markets change this dynamic fundamentally. The first, and arguably most important aspect for Information Communication Technologies (ICT) is the underlying infrastructure, in particular the consistent use of the anonymisation software Tor – 'The Onion Router' (Flick & Sandvik, 2013).

Rather than directly arriving at the desired destination, each package and request is sent through a set of relay servers. Each server only knows the server it received the package from and the next server of the chain. None of the involved servers, however, knows the entire chain. This makes it impossible to connect a user with the website they requested. It is impossible for a server to infer the IP address, and thus location of a user.

On the website level, darknet pages have a top level domain ending in '.onion'. These links are only reachable via the eponymous Tor network. '.onion' is not recognised by the internet DNS root, the system to identify top-level domains like .com or .co.uk, but special browsers (like Tor browser or the specifically designed Tails system) can use it to operate through the dark web.

The second technical solution is PGP-encryption

"Pretty Good Privacy, or PGP, is a milestone in the history of cryptography, because for the first time it makes cryptography accessible to the wide mass of privacy hungry on-line public. PGP was created primarily for encrypting e-mail messages using public or conventional key cryptography. The latter are used mainly to encrypt local files. With public key cryptography, PGP first generates a random session key and encrypts the plaintext with this key. The session key along with the ciphertext are then encrypted using the recipient's public key and then forwarded to the recipient. Other features include generating message digests, generating digital signatures, management of personal 'key rings' and distributable public key certificates. It is also designed to work off-line to facilitate e-mail and file encryption, rather than on-line transactions" (Abdul-Rahman, 1997).

Following its intention as a 'cryptographic tool for the masses', PGP breaks the traditional hierarchical trust architecture and adopts the "web of trust" approach. There is no central authority which everybody trusts, but instead, individuals sign each other's keys and progressively build a web of individual public keys interconnected by links formed by this signatures (Abdul-Rahman, 1997).

2. Trust and reputation

With the technical anonymity, one crucial market activity has been addressed, and no party of a transaction can identify the other, nor can LEAs find out who participated in a transaction (and often even whether any transaction occurred). However, this complete anonymity leads to some adverse consequences. In offline sales, dealer and buyer know each other, which is the foundation of their trust. This is not the case online, since both parties are anonymous, trust comes less easy. Meanwhile, the illegal nature of the trade leads to trust being immensely important, both online and offline (Belackova & Vaccaro, 2013; Taylor & Potter, 2013).

In offline sales the exchange of money and product happens simultaneously, and any misunderstandings can be solved between the two parties involved. In the darknet markets, vendor and buyer have no obvious knowledge about their personalities, and no trivial mechanism to resolve conflicts (Hardy & Norgaard, 2015).

The product quality cannot be tested during the purchase process and the contract cannot be legally enforced, in case either of the parties involved does not deliver (Skarbek, 2008). In this realm of anonymity and lack of a central authority with the absence of government, new decentralised institutions are created to create trust and enable a functioning market (Leeson, 2010; Powell & Stringham, 2009).

2.a Trust - reputation mechanisms (rating and forums)

In order to deal with the uncertainties of vendor reliability, processing speed and product quality, many dark markets have implemented a rating mechanism, similar to e-commerce sites such as Amazon or Ebay.

The principle builds the very foundations of trust. It has been shown that repeated

play among individuals in a marketplace reduces moral hazard and other dishonest behaviour (Resnick and Zeckhauser, 2001). Darknet markets apply these mechanisms to repeated interactions between different individuals, but allow each individual to publish their satisfaction. Vendors both have average scores of the past months of operation, and it is also possible to read the specifics of single ratings, pointing out strengths and weaknesses in vendor reliability, processing speed and product quality.

In addition to the feedback on the vendor profiles, there are a range of forums dedicated to the trustworthiness of individual vendors, further increasing transparency

(Bancroft & Reid, 2015).

As a side effect of this transparent practice, vendors aim to proactively establish trust. In the offline world, many drug dealers only service known or recommended clients, while in online environments a proactive advertising of a product to previously unknown customers is possible (Tzanetakis et al, 2015).

The role of reputation in darknet markets can hardly be understated, or, as some have phrased it, "Reputation [...] is fundamental to the community's existence" (Hardy & Norgaard, 2015), since it is needed to create a functioning market in the absence of centralised power. In light of this decentralised coordination, some theorists have likened the dynamics of the darknet to the economic phenomenon of spontaneous order (Hardy & Norgaard, 2015; Leeson, 2010).

2.b Trust - Escrow:

The second mechanism employed to build trust is the escrow. Bitcoin payments are immediately valid and cannot be undone (unlike credit card payments that can be reversed), and likewise the product, once dispatched, cannot be returned to the sender, since "drug dealers do not provide return addresses" (Hardy & Norgaard, 2015). If the buyer receives the product first, he could simply refuse to pay. Likewise, if the vendor receives the money first, there is no guarantee the product will be dispatched. Therefore, a mechanism is needed to synchronise the transaction. Instead of sending the payment directly to the vendor, the buyer sends it to a neutral third party, either the marketplace operator, or, increasingly often, an outsourced, marketplace-independent escrow service (ibd).

Once the escrow provider confirms the receipt of the money, the vendor sends the product. After the buyer confirms delivery, the escrow provider pays the vendor. If a vendor never delivers, the escrow provider simply returns the money to the buyer, deducting only a small fee (Hu et al., 2004).

3. Payment - Bitcoin

Another point of failure for a successful drug market is payment processing. In offline drug deals, the preferred mode of payment is cash, since it cannot be traced easily. Online payments typically leave an electronic trail, deanonymising sender and recipient. Darknet markets employ pseudonymous cryptocurrencies like bitcoin for payment, a 'peer-to-peer, distributed payment system that offers its participants to engage in verifiable transactions without the need for a central third-party' (Christin, 2012).

In order to create a bitcoin wallet (can be thought of as a bank account for bitcoins), no documentation is needed. However, each wallet is entirely public, and the entire history of bitcoin movements of one wallet can be traced (Reid & Harrigan, 2012). This includes the initial conversion of an established currency like dollars into bitcoin. By following the origin of the money that was used to obtain drugs, LEAs can therefore theoretically identify the owner.

There are two ways to avoid this identification from happening. Services like local bitcoin or bitcoin ATMs allow the direct transfer of cash into bitcoin, therefore from an anonymous mode of payment into a pseudonymous one. However, this requires a real world interaction of the buyer, since he needs to handle the cash.

The other option are so-called bitcoin tumblers. Thousands of users each pay a few bitcoin into a tumbling service, the services mixes them and pays out an untraceable user. While it can be shown that a user was a part of a bitcoin tumbler, it is impossible to connect the bitcoins paid in to the bitcoins received (Van Hout, Bingham, 2013).

Tumblers are either operated by market places as a part of their offering or they can be used as standalone services for a small fee.

Through the interplay of pseudonymous bitcoin and the anonymisation mechanisms of cash payments and online tumblers, the money trail has been obfuscated and become very hard to trace.

4. Logistics

The final activity darknet markets have to address for a complete transaction is the distribution of the physical product. While the other three problems are mostly digital and can be resolved with encryption and electronic measures, the distribution necessarily happens in the physical world.

The most common way to distribute purchased goods are the traditional postal services. This way, the vendor faces an extremely low risk, since their address is not known and they simply dispatch a parcel in an anonymous mailbox (Tzanetakis et al, 2015).

In order for the buyer to obtain anonymity, several methods are used in practice. The delivery address can be a dead mailbox or a wrong name can be given for the correct address. This conceals the true identity of the buyer (Tzanetakis et al, 2015).

Other means undertaken are anonymous P.O. boxes and plausible deniability. Since darknet markets allow anyone to order drugs to any address, being the recipient of a drug shipment may not be sufficient proof.

In order to verify the buyer in cases of dead mailboxes or P.O. boxes, surveillance cameras or other surveillance measures are needed to capture the moment of pick-up. However, these operations are often costly, and the cost-benefit ratio is not positive. The buyers usually purchase small amounts of product, not enough for a commercial trafficking charge. In the offline world, these types of operation are often undertaken nevertheless, in order to create a link to the supplier. Since the design of darknet markets is in a way that the buyer has no specific knowledge about the supplier beyond forum posts

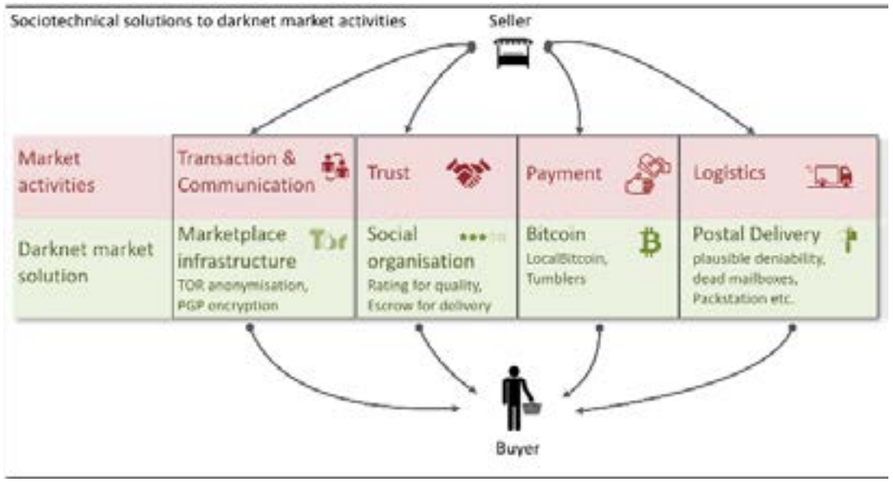

Figure 1: Socio-technical solutions to darknet market activities

and product feedback, this strategy makes no sense for online purchases (Martin, 2014).

Discussion

The review of the literature of darknet markets has brought to light an interesting situation. Darknet markets face a variety of unique challenges due to their illegal nature. ICTs like Tor and PGP allow communication and the transfer of information in anonymity. While this is a starting point for a functioning illegal online market it leads to two other issues. Firstly, anonymity is only as strong as its weakest link. Therefore, other parts of a transaction, like payments and delivery of the products, have to take place in anonymity as well. New technical solutions have emerged, like bitcoin as an electronic currency, anonymised via cash or bitcoin tumblers.

Logistics and distribution are made anonymous as well. The seller side has a very low risk by anonymously sending options of traditional postal services, while the buyers obfuscate their identity through methods like P.O. boxes under false names.

The combination of anonymity of communication and information, anonymous payments and anonymous shipping makes it very hard for LEAs to identify the transaction participants. Even occasional successes of LEAs against marketplaces do not result in widespread consequences, since market participants do not even know their counterparts' identity.

While this high degree of anonymity is an efficient protection against LEAs, it opens up problems of trust between vendors and buyers. This issue of trust is addressed in two ways. Vendors aim to establish a reputation through good ratings and reviews in the long run, while each individual transaction can be secured through a payment escrow service as well.

The mechanisms described require a degree of flexibility and willingness to acquire some technical expertise to operate in darknet markets. These higher transaction costs are partially set off by lower risks for market participants. Furthermore, research has shown that darknet markets 'reduce violence associated with illicit drugs', while also offering 'cheaper, higher quality products to drug consumers' (Martin, 2014). From a user perspective, they provide 'reliability, transparency, drug quality (mostly purity and potency)' (Bancroft & Reid, 2015) might help to further explain their emergence.

Conclusion

The study of darknet markets provides a unique insight into the emergence of alternative institutions in the absence of a legal framework and government power. Through repeated interactions and via trial and error, a proven set of social conventions and specific uses of technology emerged. The structure is much more decentralised than in traditional online marketplaces, yet the marketplace operators have the important task of facilitating interactions and providing a platform for vendors and buyers to operate.

Further research can be undertaken to understand how the iterative learning behaviour of market participants has led to the emergence of the concrete mechanisms we see today, as well as the concrete effect of the mechanisms employed by darknet markets on transaction costs.

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