Processes of Technological Change in Healthcare Organisations: An Analysis of Coordination and Effectiveness

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Abstract The main goal of the paper is to explore the importance of the complementarities between ICT and organizational change in order to plan new organizational forms. In particular, the paper analyzes whether and how technology can be an important instrument of coordination for healthcare organizations. Results from our empirical research indicate that ICT solutions and initiatives play a significant role in improved information management and therefore re-engineering of business processes. We show how traditional organizational models and coordination are no longer consistent and sufficient in turbulent environments such as that of the Italian health. ICT provides new ways of coordination and control. So the traditional coordination mechanisms are scaled or enhanced with the use of ICT.

Keywords Organizational change · ICT · Healthcare organizations

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1 Introduction

Recent literature on the productivity gains attributable to the adoption of information and communication technology (ICT) has stressed the importance of the complementarities between ICT and organisational change. ICT enables a large amount of information to be processed and disseminated and reduces information costs, facilitating a higher level of coordination. There are two prerequisites to the implementation of ICT in organisations: the codification of organisational processes and the standardisation necessary to allow for full information exchange among the various processes [1]. The introduction of ICT is less costly and more effective in internal and external corporate activities that are already formalised before an organisational change process. ICT diffusion is therefore faster in large firms and in the supply chains that they dominate. The impact of new technologies on organisational change is still moderate and appears to be strongly related to firm size. Today, challenges to organisational effectiveness arise from activities related to not only products/services but also, and more important, coordination. Most entities that collaborate need to coordinate the flow of information. Specifically, ICT can be used to facilitate not only production but also coordination in organisations to reduce transaction costs and information-related coordination costs that affect organisational effectiveness [2]. Therefore, in this study, we examine whether traditional organisational models are sufficient to promote coordination in turbulent environments such as that of the Italian health sector. ICT provides new ways of coordination and control, and thus, traditional coordination mechanisms can be scaled or enhanced through the use of ICT. The main goal of this paper is to analyse the use of ICT to plan and organise organisations with new structures, which require to organisational variables and management styles [3].

ICT is considered a strategic resource that is necessary and important for the success of healthcare organisations in the current economic climate. However, there is little empirical research on ICT in the public healthcare sector. Identifying the characteristics of the processes and the services offered by.

ICT in the health sector could help to increase the effectiveness of healthcare organisations. Accordingly, this research aims to provide an understanding of the use of ICT in the public health sector to facilitate not only production but also coordination.

2 ICT and Organisational Change

The introduction of new technologies requires the development of processes of organisational change; however, often, new ICT systems are simply used to change an existing organisational structure.

A unique relationship exists between the design of organisational structures and the role of ICT; particular organisational structures require specific information

systems to support the structure, while the availability of certain technologies or conditions favours some organisational structures over others [4]. Much discussion in the international literature has focused on the impact of ICT on organisational structures and identified four ways in which ICT affects organisational structures.

ICT significantly affects the roles, power structures, and hierarchy within organisations; ICT is used in designing new organisational structures to facilitate coordination; ICT influences organisational boundaries producing new organisational models and organisational structures based on market needs rather than internal hierarchy; and, finally, the organisational change facilitated by ICT promotes the integration of systems within organisations [5]. Technology is dynamic and influenced by the context and strategies of decision makers and users [6]. Another stream of research has studied technology as a trigger of structural change. This perspective considers technology to be a social rather than a physical object, while the organisational structure is conceptualised at a process level [7].

The introduction of ICT changes the power structure of centralised and decentralised organisational structures while modifying the existing organisational structure [8]. Technology creates new rules for coordination and control that replace traditional mechanisms of coordination based on human resource availability and capacity. In facilitate coordination [9], ICT should be used with an integrative approach [10] to manage organisations' structured processes with a high interdependence on information [11].

3 ICT and Organisational Change in Healthcare Organisations

The implementation of ICT requires an organisational change that, particularly in the healthcare sector, is complex and long lasting [12].

The introduction of information systems in any industry requires a reconfiguration of an organisation's business model, particularly the strategic planning, mission, strategic goals, and options that create value for stakeholders. The structure of the Italian healthcare system resembles "concentric rings" around citizens, the main subject of the healthcare service. Healthcare services, which are spread along a health-illness-health continuum and differentiated in terms of complexity and intensity [13] within a wider range of organisational structures, involve complex interactions between financial backers, "regulator" subjects, companies, and many other organisations. The on-going impact of the business/organisational paradigm has changed healthcare organisations from simple systems in simple environments to complex systems in complex environments.

Different levels of complexity can be detected from the degree of agreement (between the different actors involved) and the degree of uncertainty [14]. A complex healthcare system uses ICT in an evolutionary logic as a response to change and as a tool to promote the universality and equality of healthcare.

The use of ICT in healthcare organisations is based on the principle that human health is in a relationship with all other environmental realities, both natural and manmade. This approach emerged by considering the role and effectiveness of medicine and aims to address global health-related problems and both the production and the delivery of effective healthcare services.

It is important to move the centre of gravity of the change to allow citizens to become active actors who are able to take care of themselves and choose the organisation that will allow them to receive the clinical care and benefits that they perceived to be most attractive. Based on this logic, ICT has the capability to store and manipulate knowledge as well as to implement effective internal and external communication systems. The use of ICT is spreading in all healthcare sectors (form hospitals to pharmacies), affecting all existing relationships and creating new relationships among the actors. The increasing access to information inside and outside the health system allows citizens to demand more information on the state of their health, the patient path they can follow, and the supply of and available alternatives to health services that the can receive; moreover, access to such information provides healthcare managers with data on the clinical courses of patients. Information systems facilitate the development of an organisational network, ensuring that knowledge and skills can be transferred effectively.

Integrating technology into organisations requires an increase in synergies through the focused development of the existing information flows between healthcare organisations and between healthcare organisations and patients to achieve a higher level of patient satisfaction, thus increasing the relational system of organisations. Thus, an ICT framework must be implemented to handle data from several healthcare information subsystems in order to provide a social healthcare network that can generate and deliver electronic data at the right time and in the right place for anyone involved in the patient care process. Interoperability is thus essential for developing a reticular organisation, as well as a higher level of organisational analysis requested for a single healthcare organisation. ICT is the most effective catalyst with which to provide answers to the demands required by such change, as ICT can provide models and tools to coordinate the flow of information and introduce innovative elements into organisations (related to the structures of organisations, characteristics of work, and nature of the environment) [15].

4 Methodology and Research Context

ICT is a strategic resource and is essential to the success of healthcare organisations in turbulent, dynamic, and complex environments. This empirical analysis is a qualitative investigation conducted based on grounded theory. In the case of healthcare work, much can be learned about the mediating functions of physical artefacts in articulating individual activities. The grounded theory approach is a qualitative research methodology that emphasises the iterative nature of discovery, especially in studying complex human activities in a rich social context. The

essence of the grounded theory approach is generative as opposed to confirmative. Because of its nature, the theory is applicable to studies on phenomena that are not yet well defined. The grounded theory approach provides procedural guidance to qualitative analytic methodologies [16]. Our research context for the empirical investigation is the pharmaceutical sector, which is very attractive research context because of the use of new ICT devices in the sector.

The support from and use of technology in pharmaceutical facilities appear to be crucial in facilitating the drug management process. An international study has reported high rates of error in the drug supply chain [17]: 4 % error in distribution and 18 % error in the preparation phase. The same study analysed the causes of such errors, attributing 20 % of errors to working routines, 18 % to inadequate controls, 12 % to packaging, and 17 % to poor communication. Reducing the risk of errors is closely linked to policy restricting governmental expenditures on the pharmaceutical industry. Within this context, the use of technology may reduce both drug production errors and clinical risk arising from reduced pharmaceutical spending. ICT applied to the drug management process of aim to:

- overcome repetitive manual tasks, which are more prone to human error;
- ensure the traceability of the prescription, dissemination, and administration of drugs;
- distinguish between the responsibilities of the various actors involved in the process (e.g., doctors, pharmacists, nurses), allowing all actors to take ownership of their specific expertise;
- optimise the use of capital (inventories).

The study analyses a detailed and explorative case study. Pharmacies, as the object of study, were identified in accordance with So.re.sa[1] and the ASL of Caserta. In applying the methodology of a case study analysis, we gathered, coded, and analysed data from the primary and secondary sources (see Table 1) mentioned above. We used unstructured interviews with the main actors involved in the change process.

The analysis is based on the identification of key processes related to the management of pharmacies. The analysis was performed through a focus group with the management of So.re.sa and the ASL of Caserta to elucidate on the challenge of establishing coordination tools and mechanisms that are specifically geared towards bolstering ICT at both the product and the process level.

The interviews explored the following variables:

- logistics and supply processes;
- roles, structures, and workforce;
- skills and professionals involved in logistics and storage management;
- ICT for processes.

In the last phase, the cases were reviewed through discussion with and observation of participants within the pharmacies to reduce interpretative distortions.

[1] Società Regionale per la Sanità S.p.a., or So.re.sa, is a company located in the Campania region of Italy with the mission of realising strategic actions to reduce regional health expenditures.

Table 1 Data sources

	ASL Caserta
Document (*secondary sources*)	Internal reports 2009–2010–2011 Budgets Planning documents Control check-list
	Yearly reports for region and General Administrative Office of asl
Non-structured interviews (*primary sources*)	General director, administration manager, health manager of ASL Caserta interview
	CEO of So.Re.sa interview
	Managers of pharmacies interview
Direct observation (*primary sources*)	Observation of work processes analysis of interdependencies between activities analysis of interdependencies between actors (General Administrative Office of asl Caserta/pharmacies of ASL Caserta/Soresa)

5 Empirical Analysis

5.1 The Survey

Assessments were made after having visited the pharmacies and interviewing the management and heads of the local health authorities (the general director of the ASL of Caserta and So.re.sa, the administration manager of the ASL of Caserta, and the health manager of pharmacies belonging to the ASL).

The study also involved an analysis of the relevant processes, and the parameters represented a methodological framework that was used for the empirical survey.

The case study included in a field survey of 13 pharmacies of the ASL of Caserta, which have 15 warehouses.

The complexity of the Caserta area led the ASL to choose a double supply and distribution channel: one part is internalised in the pharmacy system, and the other is outsourcing (Table 2).

As shown in Table 3 and from the steady increase in the cost of drugs, outsourcing is the only organisational alternative to the operative management of the warehouse.

The constant trend of increasing orders led to an exponential effect on the overall costs of the ASL, resulting in negative overall efficiency (Fig. 1).

The annual statements and economic results were also analysed together with the governance mechanisms and the regulation of major processes: procedures, manuals, regulations, certifications, information systems, accounting systems, governance (statute and corporate agreement), management reports, service menus, organisational models/standards, and so forth.

The analysis focuses on two levels:

Table 2 Pharmaceutical logistics in figures

Movement	326.322
User	79.840
Hospital beds	782 (di cui 154 Day Hospital)
Cost of the drug for inpatient	218.479
Cost of the drug for outpatient	41.382.264
Cost of the drug outsourced	30.292.580

Table 3 Pharmaceutical logistics in figures

	2009	2010	2011
Order	5.062.118	6.994.339	7.297.300
Total cost of drug	27.115.038	56.714.933	75.805.179
Cost of the drug for inpatient	120.836	222.402	218.479
Cost of the drug outsourced	–	15.253.767	30.292.580
Cost of the drug for outpatient	25.633.613	38.364.143	41.382.264

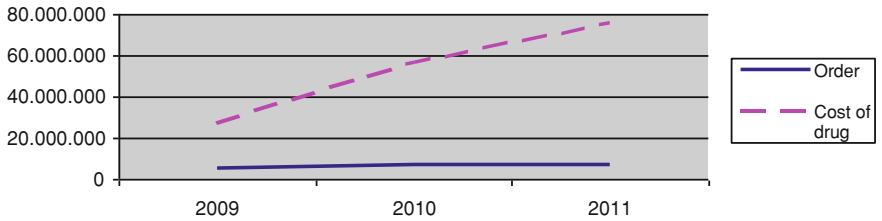

Fig. 1 Pharmaceutical logistics in figures (*Source* the authors' elaboration)

1. Studying information and activities and analysing the resources that are involved and when activities are implemented;
2. Studying the organisational structures of the pharmacies of the ASL to identify the crucial processes of the pharmacies.

In this context, we used a qualitative approach with two basic data gathering methods: *focus groups* and *semistructured interviews*.

5.2 The Case Study

This study also involved an analysis of the relevant processes, and the parameters represented a methodological framework used for the empirical survey. Assessments were made after having visited the pharmacies and interviewing the management and the heads of the local health authorities (the general director of the ASL of Caserta and So.re.sa, the administration manager of the ASL of Caserta,

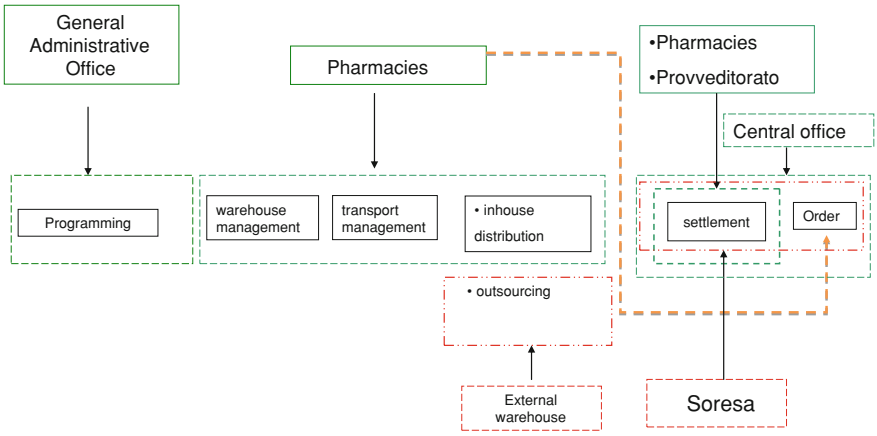

Fig. 2 The process of drug management: activities and units (*Source* the authors' elaboration)

and the health manager of pharmacies belonging to the ASL). In particular, our analysis is based on an interpretative and qualitative investigation [18] with the premise that the data and information that are collected cannot be explained or illustrated in a self-sufficient manner. Rather, it is necessary to become familiar with the material collected and elaborated during the investigation. The nonparticipant observations and the interviews allowed us to analyse and rebuild the path of drug production and distribution, mapping all the logistic and storage activities, roles, structures, workforce, skills and professionals involved, and information systems. Figure 2 shows the activities related to the crucial organisational units and the related interdependences. Planning, storage (issuance of orders and purchases), and supply activities are carried out by many actors at the same time, generating evident problems with coordination [19]. The system managing the flow of information is very articulate, with almost no coordination mechanisms. As a result, the number of warehouses in the Caserta area is nearly equal to the number of local pharmacies and hospitals in the area (Table 4).

With reference to the information system, the ASL of Caserta has a system called EUSIS[2] that is rarely used and functions poorly. As a result, all local pharmacies create their own paper records or files ad hoc. The information system for operations and order management does not determine whether results are effective; therefore, it needs to integrate data generated from the pharmacies' records into the system.

To sum up, the following critical points can be made about the information system EUSIS:

1. there is a lack of information;
2. there is no inventory management;

[2] EUSIS management information system data.

Table 4 Critical points related to pharmacies in the ASL of Caserta

	Critical points
Task	Absence of planning procedure in the phase of orders
	Two different modes of distribution: in-house and outsourcing
	Lack of a procedure for inventory control
	Lack of standard procedures (between pharmacies and Soresa)
	Lack of standard procedures (in pharmacies)
	Use of only paper report and documents
	Manual procedures of loading and unloading drugs
Material resources	Lack of equipment for optical bar-code
	Lack of equipment in the pharmacies (pc, printers, etc.)
ICTICT	"EUSIS" complex and incomplete Information system
	No integration between EUSIS system and So.re.sa system
	Information system of pharmacies not integrated with that of hospital departments
Human resources	Insufficient staff: pharmacists and administrative; Lack of warehousemen
	Low skills and professional

3. the skill level among professionals is low, and no training courses are provided for the staff;
4. there is a lack of equipment for reading optical bar codes;
5. there is a lack of an information system and digital culture among the actors;
6. there are no standard procedures;
7. there is a lack of sufficient physical space in the pharmacies.

Finally, these critical points lead to a waste of human economic and financial resources.

6 Discussion

The analysis in this study based on identifying key processes related to the management of pharmacies facilitates the measurement of the efficiency and effectiveness of new organisational models that use technology to facilitate coordination.

The analysis of the structural organisation of the pharmacies under analysis also demonstrates the need for ICT to improve logistics in the healthcare sector. The data show a high total degree of computerisation and a high level of homogeneity regarding computer equipment (PCs, software), which do not correspond to the productive use of such instruments. In addition, the various functions related to the use of technology are underutilised or, in some cases, not utilised (40 % of respondents stated that they use mostly paperless recording and accounting).

The implementation of information systems can generate value for organisations; however, if work processes are not changed to accommodate such systems

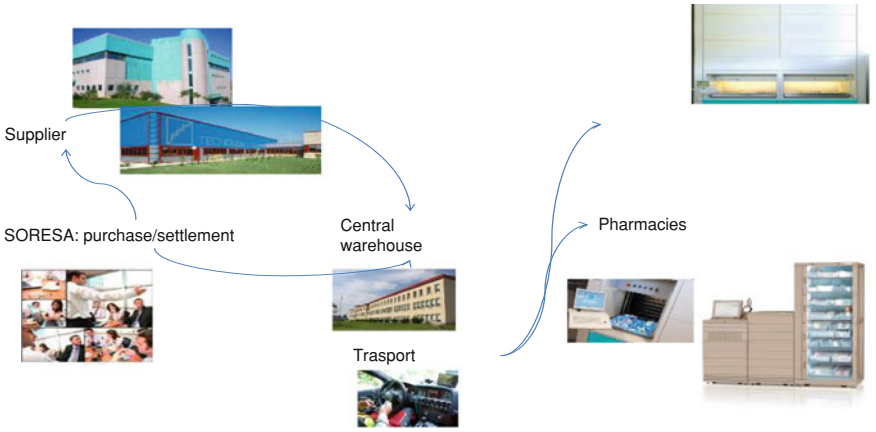

Fig. 3 The new organisational model (*Source* the authors' elaboration)

and careful and thorough training activities are not carried out effectively, ineffective routines and negative attitudes can significantly increase the costs and even prevent the success of a project to implement an information system. Creating a system to connect operations can help to organise, discover, integrate, and disseminate knowledge throughout an organisation by increasing the flow of information, facilitating individual and collective learning and supporting the sense-making and decision-making processes of pharmacy managers in the central office of the ASL.

The new organisational model brought about by the implementation of ICT involves a smaller and more centralised structure in which a central warehouse will directly supply hospital pharmacies and pharmacies within the distribution area. In this way, inventory will be a reduced, and hospital will become regional distribution points, eliminating the double handling and the related costs associated with product distribution (Figs. 3 and 4).

The technologies that were introduced have reduced the expenditures of the department, improved the effectiveness of monitoring medicines and medical devices and controlling their use, improved safety and accuracy in inventory management, reduced the number of urgent requests, provided an electronic record of product movements, optimised the distribution process and inventory management, provided controlled access to the levy through the recognition of the operator, reduced errors related to the exchange of medication, facilitated determination of real-time inventory, and allowed for precise analyses of real consumption (by drug type, department, cost centre, patient, etc.).

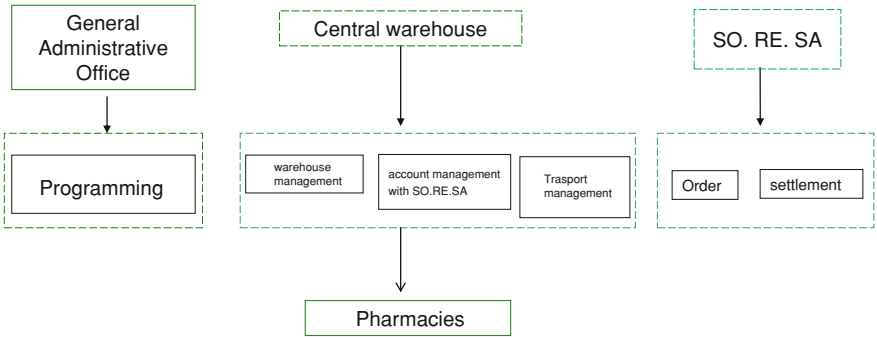

Fig. 4 The system of relationships in the new organisational model (*Source* the authors' elaboration)

7 Conclusion

ICT is considered a strategic resource that is necessary and important for the success of healthcare organisations in the current economic climate [20]. However, there is little empirical research on the use of ICT in the public healthcare sector, particularly related to organisational and technological innovation. Given the characteristics of the processes and services offered, ICT could improve organisational effectiveness in the health sector. Accordingly, this study aimed to provide an understanding of the use of ICT to facilitate not only production but coordination in organisations in the public health sector.

This paper aimed to contribute to the existing literature on organisational structures and change by analysing the impact of ICT on organisational structures. Focusing on a case study from the healthcare sector, we analysed how the external demands for efficiency from the healthcare system necessitate the introduction of information systems to support complex activities, requiring technology that generates radical changes to structure of organisations within the sector.

Nevertheless, the analysis in this paper is limited because of the focus on a single ASL from the Campania region of Italy. As a result, the generalisability of this study's findings may be limited. One limitation of this work is it analyses an completed process of implementing ICT in an organisation so we are not able to extend the results of our case study. Another limitation of this study is that we do not evaluate potential barriers to the implementation of the system, including the training of human resources and the economic return on investment compared to the cost reduction.

The goal of this analysis is facilitate the implementation of new information technologies on a local/regional level in Italy [21]. Implementing such technologies will have a positive impact on not only the performance but also the efficiency and effectiveness of healthcare services.

References

1. Orlikowski, W.J.: Using Technology and constituting structures: a practice lens for studying technology in organizations. Organ. Sci. **11**(4), 404–428 (2000)
2. Malone, T.W., Rockart, J.F.: Computers, networks and the corporation. Sci. Am. **265**(3), 92–99 (1991)
3. Rockart, J., Short, J.: IT in the 1990s: Managing Organisational Interdependence. SloanManage. Rev. **30**(2), 7–17 (1989)
4. Zuboff, S.: In the Age of the Smart Machine. Heinemann, London (1988)
5. Aldrich, H.E: Technology and organization structure: a reexamination of the findings of the Aston group. Adm. Sci. Q. **17**, 26–43 (1972)
6. Mangia, G., Pezzillo Iacono, M., Martinez, M.,Canonico, P., Mercurio, R.: The human side of organizational change: compliance and management control systems in italian public utilities, human factors and ergonomics. Manuf. Serv. Ind. **23**(1), 47–57 (2013)
7. Markus, M. L.: Power, politics, and mis implementation. Commun. ACM **26**(6), 430–444 (1983)
8. Barley, S.: Technology as an occasion for structuring: Evidence from observations of CT scanners and the social order of radiology departments. Adm. Sci. Q. **31**, 78–108 (1986)
9. Zornoza, C., Alcamí, R.: The enabling role of information technologies on the emergence of new organizational forms. Organ. Downsizing **2**(3), 251–261 (1999)
10. Grandori, A.: Organization and Economic Behaviour. Routledge, London (2001)
11. Rockart, J.F., James, E.: Short: IT in the 1990s: managing organizational interdependence. Sloan Manag. Rev. **30**(2), 7–17 (1989)
12. Fulk, J., De Sanctis, G.: Electronic communication and changing organizational forms. Organ. Sci. **6**(4), 337–349 (1995)
13. Checkland, P.B., Holwell, S.E.: Information, Systems and Information Systems: Making Sense of the Field. Wiley, Chichester (1998)
14. Cicchetti, A.: La progettazione organizzativa: Principi, strumenti ed applicazioni nelle organizzazioni sanitarie. Franco Angeli, Milano (2004)
15. Bonacci, I., Tamburis, O.: Deploying new concepts of network organizations for chronic diseases integrated management. Int. J. Inf. Syst. Serv. Sect. Special Issue **2**(3), (2010)
16. Tornatzky, K.: How organizations adopt and implement new technologies. In: Acad Manage Proc 1987 (Meeting Abstract Supplement), pp 175–179 (1982)
17. Chatelain-Bernheim, C.: Analyse méthodologique du risque nosocomial d'erreur médicamenteuse:à propos de 319 notifications sontanées du Réseau REEM. Thèse mastère spécialisé Gestion des risques dans les établissements de santé, École Centrale Paris, 26 March 2003: 61 pages
18. Strauss, C.: Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Sage, London (1988)
19. Birkinshaw, J., Brannen, M.Y., Tung, R.L.: From a distance and generalizable to up close and grounded: reclaiming a place for qualitative methods in international business research. J. Int. Bus. Stud. **42**(5), 573–581 (2011)
20. Martinez, M., Pezzillo Iacono, M.: Dealing with Critical IS research: artifacts, drifts, electronic panopticon and illusions of empowerment. In: Baskerville R., De Marco M., Spagnoletti P. (eds.) Designing Organisational Systems—An Interdisciplinary Discourse. Springer, Berlin, pp. 83–102 (2013)
21. Pezzillo Iacono, M., Martinez, M., Mangia, G., Canonico, P., De Nito, E.: Coping with power of control: the role of IS in an Italian integrated tariff system. In: Spagnoletti, P. (ed.) Organizational Change and Information System. Working and Living Together in New Ways, pp. 313–325 (2013)