

PhD proposal: Enterprise modelling of rule networks in organisational collaborations^{*}

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Abstract

Organisations and their activities are largely controlled by different types of rules. Rules can have particular importance for organisational collaborations, for example in healthcare, in which negative effects of rules at different levels are identified. Rules have interdependencies with other rules, forming rule networks, which may be examined using systems and organisation theory. Rules can also be modelled through enterprise modelling. However, present models seem to have limited support for representing rule networks and understanding the emergence of unforeseen and undesired effects on the boundaries of the action space of collaborating organisational units. This gap will be addressed through the design of a modelling language with an accompanying method and tools, using Design Science Research.

Keywords

organisational collaboration, enterprise modelling, business rule, rule network, design science, systems thinking

1. Introduction

This paper is the first published description of a PhD project started in January 2023.

Organisations and their activities are largely controlled by different types of *rules* [1]. Although rules are meant to bring about order, they can often have unintended and unexpected consequences. While some rules have external origins, such as laws and regulations, others are made by the organisational units themselves to fulfil their goals. The reason for some of these internal rules is compliance with external rules. Most organisational rules have interdependencies with other rules through e.g. explicit citations, forming *rule networks* that evolve over time [2]. These networks together set *boundaries* that limit the action space of organisational units.

Rules can have particular importance for *organisational collaborations*, which horizontal nature limits the degree of control that can be exercised by direct commands. One industry that is both highly controlled by rules and reliant on organisational collaboration is healthcare, making it an intriguing area for research about these two concepts. One problem in healthcare is that many general practitioners find it nearly impossible to adhere to all applicable medical recommendations [3, 4]. Another issue, in a Swedish context, is that the monetary incentives

13th International Workshop on Enterprise Modeling and Information Systems Architectures (EMISA), May 11 and 12, 2023 – Stockholm, Sweden

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CEUR Workshop Proceedings (CEUR-WS.org)

that drive the healthcare system make many practitioners take actions they believe are at odds with their professional expertise [5, 6]. A third problem is that privacy regulation [7], most notably the European Union's General Data Protection Regulation (GDPR), makes it difficult for caregivers to share data with each other about patients in inter-organisational care processes [8]. The significance of the above issues is shown by the protracted debate about healthcare that they have generated.

A contributing factor to all three aforementioned issues is that they arise from a complex network of interdependent rules and regulations. The difficulty of comprehending and managing these networks is the research problem addressed in this PhD project.

2. Knowledge Base

This section will present theoretical foundations for understanding rules as well as closer definitions of some central concepts.

2.1. Perspectives from Sociology and Systems Thinking

Starting with a broad view, it is noteworthy that the growth of increasingly detailed rule networks is intimately connected with the advancement of modern society. Already Emile Durkheim observed in 1893 that "domestic law, from being originally simple, has become increasingly complex" [9, p. 155]. Later, Max Weber, otherwise a strong proponent of bureaucracy, cautioned that an *iron cage* of rules [10] could be humanity's *inescapable faith* [11].

In a nearly empty world, i.e. loosely coupled system, it is easier to do local changes without negative effects [1]. Hence, more rules increase the complexity of the system, and its management. Like any system, organisations and organisational collaborations can be subject to the emergence of new properties, qualitatively different from the properties of the components. Some of these new properties, stemming from *strong emergence* cannot be foreseen [12].

An important point by Simon [13] is that advances in human knowledge can both increase and decrease the amount of knowledge that needs to be mastered by professionals. In the latter case, the needed knowledge is lessened as a result of the discovery of more universal laws. In a similar manner, rules can both increase and decrease the *residual variety* [14] (cited in [15]) that an organisational unit has to manage.

2.2. Organisational collaboration

This research project understands organisational collaboration as a type of organisational coordination distinct from both hierarchical chains of command and market mechanisms [7]. There is typically no clear hierarchy among the actors, vague limitations of responsibility, and the driving force is rather common goals than immediate return in forms e.g. revenue. Collaboration can be both intra-organisational (between units) and inter-organisational (between organisations).

Collaboration occurs both around particular cases, e.g. the treatment of a patient, and when designing general work conditions, such as when one organisational unit establishes a routine that affects other units, as in the problem of medical guidelines in Section 1.

2.3. Rules and Enterprise Modelling

Rules, goals, and other aspects of an organisation can be modelled through *enterprise modelling*. This technique is useful for e.g. visualizing the interdependence between various organizational components and can involve analyzing, assessing and designing [16]. Two important parts of enterprise modelling relating to this project are *goal modelling* and *business rule modelling*. Here follows a brief description based on the 4EM method [16].

A goal model describes what an organisation or collaboration wants to achieve, and how goals are interdependent. An example of a goal could be, say, "improved preventive care of overweight patients." Some modelling languages, such as iStar [17], can express which actor has which goal.

Business rules can be of three different types [16]. A *derivation rule* defines a concept based on information about other concepts that are already present in the system. For instance, an overweight patient could be defined as "a patient that has a Body Mass Index (BMI) above 25.0". An *event-action rule* states what to do in specific situations. For example, "if a patient is overweight, perform the NICE guideline 'Physical activity: brief advice for adults in primary care'". (NICE is a set of medical guidelines in the United Kingdom [3]). A *constraint rule* ensures the information integrity of a system or sets limits on organisational behaviour. This could entail, e.g., deciding that "all patients must be treated according to applicable NICE guidelines". As this example shows, the implication of a particular rule on the boundaries of the action space of an actor much depends on interdependent rules.

Compared to Sandkuhl et al. [16], this research project has a broader initial understanding of organisational rules, including e.g. organisational culture and non-binding recommendations of best practice. A working definition is: a control mechanism that defines the boundaries of the action space of an organisational unit or role in a type of situation. This scope will likely be narrowed during the research process.

2.4. Rule Networks

An apparently rather new concept in the field of organisations is what Zhu and Schulz [2] refer to as *rule networks*. Their research aims at comprehending the growth and mutual citations of medical guidelines. Citing Simon [13], Zhu and Schulz recognize that regulators, like all humans, operate with *bounded rationality* in a myopic manner. Thus, the regulators will not be able to predict all the consequences that new rules will have on all parts of an organisational system.

There is more to rule interdependence, however, than citations. A second aspect is having the same creator. A third aspect is governing the same actor or situation, in a reinforcing, neutral or conflicting manner. A fourth aspect is common implications (both intended and actual, costs as well as benefits). Just as for the definition of organisational rules in Section 2.3, this research project has a broad initial understanding of rule interdependence, that encompasses all the mentioned facets. Joining these concepts, the preliminary definition of a rule network for this project is: a set of interdependent organisational rules that affects a situation.

3. Preliminary Research Goal

The section outlines the preliminary research goals of the PhD thesis project. They are likely to change as the project unfolds.

The first research goal is to design a modelling language for organisational rule networks. As for requirements, there are a number of potential perspectives to explore. First, the language should represent the aspects of interdependence described in Section 2.4. Second, it should represent feedback mechanisms of rule change. A rule maker must learn what the actual consequences of a rule change was, compared to the intended. Third, the language should (if feasible) allow for computations of quantifiable properties of a rule network, which helps in understanding aggregated and emergent effects on organisational units.

The second goal is to design a method for using the modelling language to represent a rule network of a particular organisation. The third goal is to make a tool for this purpose.

Ideally, an organisation would model all its rules and relevant external regulation as a rule network. However, that is likely a poor use of resources. A more realistic approach would be to start modelling the rules that seem to have the greatest impact on a concrete problem at hand, and then expand the network until the benefits of improved understanding no longer seem to outweigh the labour cost. As more problems with accompanying rules are added, the islands will connect and form a growing landmass.

So what could constitute a concrete problem to tackle? One situation could be when practitioners seem unwilling to follow the rules. Modelling their rule networks can help in comprehending the many – perhaps conflicting and overwhelming – demands they are dealing with. Another scenario would be when an IT system needs to be designed for inter-organisational use in a heavily regulated environment, such as a system for Health Information Exchange (HIE). Modelling relevant rule networks will help in eliciting requirements to properly embed the regulations in the system.

In the long run, the resulting artefacts could be part of the design of *Digital Twins* for organisations. Digital twins have now evolved to the point where they can be used also for sociotechnical systems [18].

4. Preliminary Research Methodology

The over-arching research framework will be *Design Science Research* (DSR) [19] as described by Johannesson & Perjons [20]. The DSR cycle envisions the use of different research strategies and methods being applied at various phases. The first step will be to conduct a systematic literature study to complement the knowledge base with regard to enterprise modelling methods that have been proposed for rules in organisational contexts. Capturing their limitations in detail will allow a more precise appreciation of the research gap that the PhD project seeks to fill. To further explicate the problem and elicit requirements, a case study of organisational collaboration in healthcare in Region Stockholm is planned. After having designed the envisioned artefacts, the case study can be continued for demonstration and evaluation. Note that in spite of the chosen focus on collaboration in healthcare, the ambition is that the resulting artefacts will be applicable to rule networks in general.

5. Concluding remarks

Rules and rule networks can have undesired and unforeseen effects in organisational collaborations, for example in the healthcare industry. This problem can be addressed through the design of a modelling language for rule networks.

References

- [1] J. G. March, H. A. Simon, *Organizations*, John Wiley & Sons, 1993.
- [2] K. Zhu, M. Schulz, The dynamics of embedded rules: How do rule networks affect knowledge uptake of rules in healthcare?, *J. Manag. Stud.* 56 (2019) 1683–1712.
- [3] M. Johansson, G. Guyatt, V. Montori, Guidelines should consider clinicians' time needed to treat, *BMJ* (2023) e072953.
- [4] N. Privett, S. Guerrier, Estimation of the time needed to deliver the 2020 USPSTF preventive care recommendations in primary care, *Am. J. Public Health* 111 (2021) 145–149.
- [5] M. Zaremba, *Patientens pris: ett reportage om den svenska sjukvården och marknaden*, Weyler, 2013.
- [6] H. Kjöllér, Hanne Kjöllér: Det allmänläkarna utsätts för är inget annat än byråkratisk misshandel, *DN. SE* (2023).
- [7] C. Auschra, Barriers to the integration of care in Inter-Organisational settings: A literature review, *Int. J. Integr. Care* 18 (2018) 5.
- [8] K. Fast Lappalainen, U. Fors, M. Henkel, C. Magnusson Sjöberg, E. Perjons, *Digitalisering inom vård och omsorg*, Technical Report, Stockholm University, Stockholm, 2021.
- [9] E. Durkheim, *The Division of Labor in Society*, Simon and Schuster, 1997.
- [10] M. Weber, *The Protestant Ethic and the Spirit of Capitalism*, Routledge, 1930.
- [11] M. Weber, *Economy and Society: A New Translation*, Harvard University Press, 2019.
- [12] M. J. J. Colchester, *Systems + Complexity An Overview*, 1st edition ed., CreateSpace Independent Publishing Platform, 2016.
- [13] Simon, H. A., *The Sciences of the Artificial*, volume 3rd ed, The MIT Press, 1996.
- [14] W. R. Ashby, *An Introduction to Cybernetics*, Springer New York, NY, 1956.
- [15] J. P. Ríos, Systems thinking, organisational cybernetics and the viable system model, in: J. Pérez Ríos (Ed.), *Design and Diagnosis for Sustainable Organizations: The Viable System Method*, Springer Berlin Heidelberg, Berlin, Heidelberg, 2012, pp. 1–64.
- [16] K. Sandkuhl, J. Stirna, A. Persson, M. Wißotzki, *Enterprise Modeling*, Springer Berlin Heidelberg, 2014.
- [17] F. Dalpiaz, X. Franch, J. Horkoff, *istar 2.0 language guide* (2016). [arXiv:1605.07767](https://arxiv.org/abs/1605.07767).
- [18] M. Caporuscio, F. Edrisi, M. Hallberg, A. Johannesson, C. Kopf, D. Perez-Palacin, Architectural concerns for digital twin of the organization, in: *Software Architecture*, Springer International Publishing, 2020, pp. 265–280.
- [19] A. R. Hevner, S. T. March, J. Park, S. Ram, Design science in information systems research, *Miss. Q.* 28 (2004) 75–105.
- [20] P. Johannesson, E. Perjons, *An Introduction to Design Science*, Springer International Publishing, 2014.