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INFORMATION SYSTEMS GOVERNANCE AS A SYSTEM OF RULES: HIERARCHICAL AND HETERARCHICAL IMPLEMENTATION

Research in Progress

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Abstract

Information Systems Governance (ISG) can be defined as a set of rules allowing executives and skateholders to determine how they will decide on the Information System management. The first objective of this paper is to propose a set of meta-rules addressing different aspects of ISG, which are instantiated in each company setting. The second objective is to propose two constrasting models of ISG, which instantiate differently the set of rules. Conventional view of ISG includes hierarchical and centralized control with little flexibility to support rapidly changing organizations. Heterarchical forms are more and more frequently observed in ISG practices (agility, transversality, decentralization…). However, if uncontrolled, heterarchy can lead to the emergence of anarchic phenomena, such as instability, increased conflicts, and waste of resources. Approaching ISG through rules implementation can help controlling heterarchical forms. In the first part of our paper, we describe an ISG as a set of the rules, based on Elinor Ostrom's work and her IAD (Institutional Analysis and Development) framework. In a second part, we develop each type of rule first according to a hierarchical view, then to a heterarchical one. Beyond theoretical contribution, the proposed set of rules can help CIOs involved in improving ISG. It can also be used to make an organizational analysis of heterarchical practices of a company's ISG.

1   Introduction

According to (Reix, 2004), an information system is " *an organized set of resources: hardware, software, personnel, data, procedures ... to acquire, process, store information (data, text, images, sounds, etc.) within and among organizations*". Those resources generally constitute a strategic asset for the company, and they have to be managed. Information System Governance (ISG) relates to how IS resources are managed. It is considered a business imperative for bringing value of information technology. Weill (2004) defines ISG by stressing on decision: ISG is a management process for controlling decisions and the underlying risks. It describes the distribution of IS decision-making rights and responsibilities. Such a management process is usually based on best practices (Jacobson, 2009), and connected to strategic alignment. From a professional point of view (Cigref, 2002, p.11), ISG is "*the combination of steering, which ensure that today's decisions properly prepare for tomorrow, and control*". Cornu-Emieux and al (2009, p.13) consider governance as "*a set of rules and methods to rationally control the information system adequacy with company's objectives and resources*". Thus, we can be consider ISG as a set of rules that allow executives and skateholders to determine how they will decide together, how they will run actions and strategy, and how they will monitor and evaluate them. In practice ISG is often confronted with issues concerning authority, role assignment, information and knowledge sharing, coordination, decisions. The first objective of this paper is to propose a set of meta-rules addressing different aspects of ISG, which are instantiated in each company setting. The second objective is to propose two constrasting models of ISG, which instantiate differently the set of rules. Conventional view of ISG includes hierarchical and centralized control with little flexibility to support rapidly changing organizations. In order to deal with organizational transformations, Chief Information Officers often face complexities and challenges: rapidly changing environment, rigid and slow procedures, growing demand for agile practices… ISG hierarchical model does not resolve those issues because reactivity is not a key concern. Heterarchy could provide an answer to current challenges. This concept refers to polycentrism, partial autonomy, local control, limited centralization, collaboration, transversality, and temporary organizations. A heterarchical system differs from a hierarchical one because it favors decentralization, interrelation and cooperation among members rather than a centralized operation based on a top-down structure. A heterarchy is defined as a polycentric organization, that is to say that more entities (at the same level or at different levels) have a self-regulating, which leads to phenomena of emergence. Some heterarchical forms can already be seen in information systems department practices: project mode, collaborative work[1], cross-functional management, collective decision-making, overlapping entities and interactions with multiple links between members. However, if uncontrolled, heterarchy can lead to the emergence of anarchic phenomena, such as instability, increased conflicts, and waste of resources. Approaching ISG through rules implementation can help controlling heterarchical forms.

In the first part of our paper, we describe an ISG as a set of the rules. In a second part, we develop each type of rule first according to a hierarchical view and then to a heterarchical one.

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[1] According to the Gartner Group, collaboration is placed higher in the priorities of French CIOs in 2014 compared to their international counterparts.http://pro.01net.com/editorial/611860/les-dsi-conscients-des-defis-numeriques-qui-les-attendent-mais-mal-prepares/

2   INFORMATION SYSTEM GOVERNANCE AS A SYSTEM OF RULES

The social regulation theory has been developed by French sociologist Jean-Daniel Reynaud since the 1970s. It is based on the concept of "*rule*". Reynaud (1997) tries to understand how rules can sustain social group and collective action. Negotiation and rules are central to social relations. They help understanding current debates and stakes in our society (De Terssac, 2012).

According to Reynaud (1997), "*a rule is an organizing principle. It can take the form of an injunction or prohibition to strictly determine a behavior. Most often it is an action guide, a yardstick for judging, and a model for action. It introduces meanings, partitions, and links in the symbolic world.*"(p.4). One often speaks of "rule of a game", which is a set of principles governing how a game should progress. It sets how we should play while conforming to these rules and requirements. The interdependence of rules constantly interacting, which is part of the concept of a rule system, is of major interest for us. To implement an ISG means setting operating rules. A system of rules includes several types of rules, both autonomous and interacting with others. They apply to "*collective action, as the main object of management science*" (Teulier and Lorino, 2005).

A major contribution to rules system in connection with organization of collective action is that of Elinor Ostrom's (Ostrom, 1990; Polski and Ostrom 1999; Crawford and Ostrom, 2005). Her theoretical framework represented by the IAD (Institutional Analysis and Development)[2] model "is used as an analytical framework for the analysis in cases where management is shared. Her analysis focuses on a conceptual unit, called "*Action Arena*", where actors interact in social situations called "*status share*" (see Fig.1). In such an arena, participants interact, exchange goods and services, solve problems, dominate or fight in (Ostrom, 2005). Several external factors, called "*exogenous variables*", affect interactions and outcomes.
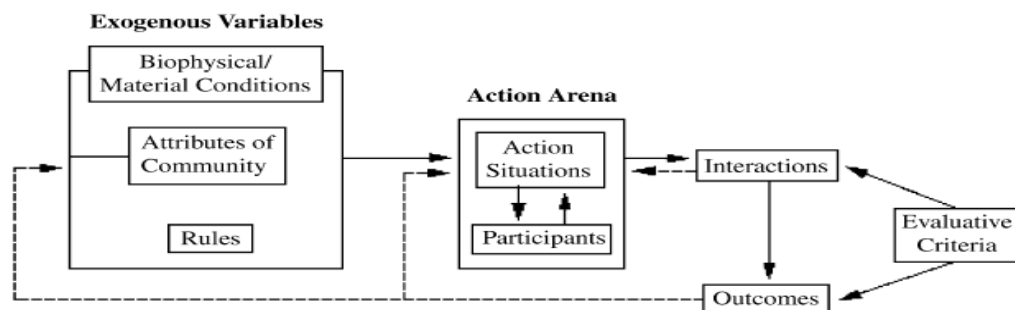

Figure1.   The IAD Framework model (Ostrom, 2005)

Changing the rules which guide the action situations in an arena can help changing the system. Rules are often identified by the actors themselves as the main vector of change. Most often, actors involved in conflict solving consider that establishing new rules is a priority.

Recent research in information systems use the model IAD (Tenenberg, 2008), sometimes concerning agile practices (Montgomery, 2014). Elinor Ostrom has defined a set of rules that we have adapted for

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[2] It is described more explicitly in the work of Ostrom "Rules, Game and Common-Pool Resources" (Ostrom and al. (1994). This model is the IAD collective result of many diverse social scientists who participated in the Workshop in Political Theory and Policy Analysis in the past 25 years (Polski and Ostrom, 1999).

describing an ISG at a meta-level. We have added rules related to coordination and rules related decisions. Our framework includes nine types of rules: R1 to R9. We will give a brief definition of each of them.

2.1 Position rules, R1

Position rules specify which positions, in a given situation of action, may be taken by each category of actors. They help define the actions associated with a given position. To identify the form taken by R1 in a particular context, one should ask: what are the roles of different actors in this situation?

2.2 Boundary rules, R2

Boundary rules specify how actors should be chosen to enter a given role. They help define which actor may participate in the given action situation. To identify the form taken by R2 in a particular context, one should ask for each role: which participants can access the role?

2.3 Authority rules, R3

Authority rules specify the extent of each player's power of control. They provide information on each participant's level of control on action in a particular situation. They specify what a participant in a given position, may, should, or should not do within a decision process. To identify the form taken by R3 in a particular context, one should ask: Which activities are allowed to the participants, and how these activities affect the outcomes of the process? What is each participant's level of control on the process?

2.4 Information and knowledge rules, R4

Information and knowledge rules specify channels of communication between stakeholders, and which information and knowledge may, should, or should not be shared. To identify the form taken by R4 in a particular context, one should ask: which information and knowledge on the situation of the action is available to participants? How information and knowledge are distributed?

2.5 Coordination rules, R5

Coordination rules specify how between actors and units coordinate. To identify the form taken by R5 in a particular context, one should ask: which are methods and mechanisms for coordination? How can collective action be coordinated to achieve tasks? How does one assume coordination?

2.6 Decision rules, R6

Decision rules specify what decisions are assigned to a player in a given position. They provide information on how the action is organized at different nodes of a decision tree. To identify the form taken by R6 in a particular context, one should ask for each situation of action: who decides on what?

2.7 Aggregation rules, R7

Aggregation rules define how the decisions of actors to a node should be connected to intermediate or final results. They refer to generic forms of decision, for example, according to a majority rule or unanimous rule.

2.8 Scope rules, R8

Scope rules define how the actors' behavior affect expected outcomes and by what extent. Will there be room for the initiative? Or should actors comply with the rules? To identify the form taken by R8 in a particular context, one should ask for each situation of action: what autonomy and initiative are left to actors?

2.9   Payoff rules, R9

Payoff rules specify how rewards should be distributed to players, based on their actions and results. To identify the form taken by R9 in a particular context, one should ask for each situation of action: what can players committed to action and results, expect in return?

3   HIERARCHICAL GOVERNANCE VERSUS HETERARCHICAL GOVERNANCE

Minzoni (2010) identifies two contrasting views on governance: hierarchical and heterarchical. The first one is grounded on collective mistrust and desire for control; main answers are frameworks and procedures to mitigate risks. The second one is a kind of utopia, where long-term social cohesion is achieved through multipolar co-controlling. The two governance regimes can be fully apprehended for ISG using our set of rules. For each type of rule, we will give two versions, hierarchical and heterarchical, with examples.

3.1   The position rules, R1

3.1.1   Hierarchical implementation

In a hierarchical variation, each player has an initial position or predefined role on a static chart, at a given hierarchical level, associated with defined responsibilities, and is obviously qualified. For example, a MIS organization can draw a clear hierarchical distinction between "senior developers" and other "junior developers", which are both classified under "software engineering engineer" on the organizational chart.

3.1.2   Heterarchical implementation

In a heterarchical vision, there is a kind of equality between roles, and sometimes roles are redistributed. For example in the "*open source*" community, there is a principle of egalitarian roles. Software modules are "*free*" or open source, and each actor can copy, transform, combine them, and then share the results with otehers, for advancing a collective project (eg linux[3], wikispeed[4]).

3.2   The boundary rules, R2

3.2.1   Hierarchical implementation

In a hierarchical variation, the access rule to the role is almost fixed, linked to a stable skill. It is used at one level and can not be exploited optimally at other levels. Therefore, skill is chosen only once, for a fixed role and housed in a single hierarchical level. For example, in a department "*purchases*" a lawyer is responsible for drafting legal clauses of specifications and can not be assigned to another department. Thus, in a hierarchical view skill is linked to the role and level uniqueness.

3.2.2   Heterarchical implementation

In a heterarchical variation, actors are chosen first of all with regard to their ownership of capacity (capacity for innovation, autonomy, etc.) or skill. This criterion is a decisive element for the

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[3] Linux is a UNIX-type operating system, its main peculiarity of Linux is to be free software, developed collaboratively and largely volunteer hand by thousands of programmers around the world. https://aful.org/ressources/presentation/linux

[4] WIKISPEED is a United States registered automotive manufacturer and a Washington State, USA, non-profit company with R&D inputs from a global think-tank collaborating using Agile project management and open source licensing (http://wikispeed.org/).

establishment of a coherent actor group. Belonging to a hierarchical level intervenes only second. For example, we can find heterarchy in the structure: the division of responsibilities is not purely down (vertical), but can combine geographic, specialized skills, particular local interest.

3.3 The authority rules, R3

3.3.1 Hierarchical implementation

Because they are in charge, leaders often do not try to demonstrate how sound their strategies are. They are not necessarily wrong because the hierarchical principle does not require taking subordinates' opinion. The only thing that is really important is to convince superiors (Dupagne, 2012). The hierarchical operation generally corresponds to a pyramidal distribution of authority, in which lower levels are subordinated to higher levels. However in hierarchical systems, one can observe decision-making process that does not respect the hierarchy.

3.3.2 Heterarchical implementation

In this vision, individualized authority is not popular because the authority is everyone's business and achieved collectively by all. Indeed, the responsabilities of powers are shared in line with the key skills. According to Aime et al., (2014) "*a power heterarchy within teams as a relational system in which the relative power among team members shifts over time as the resources of specific team members become more relevant (and the resources of other members become less relevant) because of changes in the situation or task* " (p.328). For example (Hedlund, 1986) mention a multinational company (MNC multinational corporation), in which R & D center is based in the Netherlands with responsibility for coordinating product development, while a center in Singapore responsible for the Asia market, another center in London is responsible for common purchases across the MNC and the responsibility of the main product is localized in charge of product division in Germany. Unlike a matrix operation, the conflicts must be resolved not by the intervention of a higher authority, but through negotiations.

3.4 The information and knowldge rules, R4

3.4.1 Hierarchical implementation

In hierarchical organizations, information and knowledge are moving to the hierarchy, they are centralized at the top in particular by the decision maker. The withholding of information is shown by Crozier as a source of power (1964). In this vision "the one who holds the information is the one who has the power". Furthermore, knowledge and information are located at each node and are only handled by superiors. If another node needs these resources, it can be accessed only through the hierarchy. This explains the development of individualism spirit: "*I treat information I manage knowledge at my level, to be transferred to my supervisor*". The flow of information[5] generally follows a hierarchical traffic, rather down, where information spreads from superior towards his subordinates. However, communication networks in the business do not always respect the established chart. Indeed, informal communications have always existed. Spontaneous, they have always been a source of information flow in organizations. For example, information about a possible takeover of the company by a competitor can flow quickly into the business and lead to serious consequences for the mobilization and involvement of employees.

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[5] The flow of information is generally related to the organizational structure of the company.

3.4.2 Heterarchical implementation

Today we are in a predominance of Information and Communication Technologies (social networks, big data, collaborative platform, etc) that allow and demand for information and knowledge sharing at multiple scales. This sharing of information and knowledge useful associated with collective action can develop a transparency strategy that in turn calls confidence to collectively solve related problems. For example, according Ertzscheid "*with Twitter, which dominates at first is the aspect heterarchical deep, flat, information that circulates. There is talk of heterarchy from the time when, in an organization, there is no "higher level" [...] Twitter is, prima facie, a heterarchy: editorialisation no, no "higher level" of information. So Twitter is literally unreadable, because its nature is precisely to reject "setting an order" or prioritizing. Yet Twitter is read*"[6].

3.5 The coordination rules, R5

3.5.1 Hierarchical implementation

In a hierarchical implementation, coordination is built by directives or standards following a center of command. It is preset in the vertical static chart, i.e., coordination between the superior and his subordinate is translated by contractor and the execution of the order or the submission of obedience. For example Hedlund (1986) speaks of MNC ethnocentric as an organization in which the parent company alone ensures the coordination and control of subsidiaries. It imposes its rules and its control in all subsidiaries. These are usually run by executives from the parent company.

3.5.2 Heterarchical implementation

Coordination is the result of an agreement on knowledge, rules and standards that define the interactions between individuals within a perspective of collective action. The question of what grounds the agreement remains a central issue. According to Ostrom, the problem of collective action is based on a type of coordination that allows the voluntary cooperation of individuals, not their submission to decision-making authority as in the case of the "*hierarchical coordination*" (Hubert and al., 2009). This type of coordination will be ensured by multiple means, and interactions between individuals. Indeed, the heterarchical type of coordination process takes the form of a "mutual *adjustment*"[7], *it represents* the weaving of interdependence among individuals, based on egalitarian rules on the principles of collaboration. Individuals assume the coordination of a given collective action. For example, the MNC heterarchical described by Hedlund (1986) is not limited to a single center, and this polycentrism aims at favoring the reactivity and the innovation. New ideas or new products are not created on the initiative and under the control of the parent company, even if the exploitation is then global. Thus, the subsidiary of a country can be the initiator of activities in one area, and then become global coordinator for the development of these activities and at the same time act as a single distributor in other areas.

3.6 The decision rules, R6

3.6.1 Hierarchical implementation

A hierarchical organization operates with reference to a flowchart ranging responsibilities and powers of each entity. In a given node, each actor is responsible for controlling activities, and can make decisions according to the prerogatives that they are assigned to him, and he should report to his immediate superior of the executed results. Here we are in a posture (the donor orders, on the one hand

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[6] Ertzscheid Olivier, "*Twitter: hieratical against the hierarchical*" Affordance.info, ISSN 2260-1856. July 5, 2009.
[7] This means that coordination between the tasks is ensured through informal communication between individuals (Mintzberg, 1983).

and on the other hand, the execution of the order relying on submission or obedience). In fact, decisions are taken by the supervisor at each level of the structure. The leader, whatever his level, by definition, is responsible for the decision. He is supposed to be the best suited to make decisions, that's why he was appointed. This method of decision-making can be described as "lonely" because "performers" are not consulted. In brief, the leader decides, but is not responsible yet, it is the hierarchy which carries in fine all the responsibility, and the subordinates execute (Delstanche, 2014).

3.6.2   Heterarchical implementation

The concept of delegation of responsibility is very important. The delegation is led by a rational mechanism, "*the principle of subsidiarity*", which guarantees a careful and precise choice of expertise in this area, and encourages operation in a standalone mode at all levels of the organization. For example, in the case studies conducted by (Morley and Bia-Figueiredo, 2013), one project leaders when confronted with a complex specification to treat, requiring it to be distributed among several employees, especially working with a collaborator he calls "*referent*", privileged according to the criterion of trust. Here, the designation of the referent is not related to his position, but rather to trust. Thus, all the actors have side responsibilities themselves to solve simple problems or complex and take appropriate decisions. The empowerment process[8] expands on multiple levels.

3.7   The aggregation rules, R7

3.7.1   Hierarchical implementation

In a hierarchical vision, sense of decision is always downward. The decision is made by one person. Wee are close to the image of "*brain of the firm*". Indeed, decisions are linked to hierarchical positions. Decisions are limited to certain categories of people (managers, etc.). Decision making is realized at high levels of the hierarchy and the base executes the tasks without participating in the decision making process. This type of structure includes all mass production companies, such as line production of the automotive industry (Briol, 2008, p.53).

3.7.2   Heterarchical implementation

A heterarchical variation is close to the image of the "*firm as a brain*", where each actor can be considered a manager and make decisions. Heterarchy is seen as a self-organizing management system: "*In self-organizing managerial system, each participant est aussi a manager of this system. Such a system has s'intitule "heterarchy" (hetero: other and archein: to rule), for at Any Time May it be one of your neighbors who is making the decision, you did Reviews another, as the neighbor of others*" (Von Foerster, 1984, p.8). A proper decision mechanism is "*concertation*". A US study (Beierle and Cayford, 2002) based on 239 cases since 1970, gives the following results: dialogue has changed or has helped change final decision in 58% of cases; consultation processes have resolved the conflicts in 61% of cases; they have increased confidence in the agency who led the dialogue in 45% of cases; they increased the understanding of the subject by participating in 77% of cases.

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[8] The process by which a person or a social group acquires control means which enable it to raise awareness, strengthen their potential and transform in the perspective of development, improving living conditions and environment. http://www.oqlf.gouv.qc.ca/ressources/bibliotheque/officialisation/terminologique/fiches/1298948.html.

3.8 The scope rules, R8

3.8.1 Hierarchical implementation

In a hierarchical implementation actors have strong propensity to the respect of rules and standards and sometimes without making enough efforts initiative. This develops heteronomy actors in multi levels.

3.8.2 Heterarchical implementation

The expected outcome requires strong reactivity between actors and more agility and independence in problem solving, conflict of explanation and reconciliation of decisions of the place and time. Confidence and increase transparency grows up within the organization. For example, the comparative study between Japanese and US companies made by William Ouchi in the 1980s revealed that Japanese companies success secrets based on the mastery of the concept of heterarchy: "In the early 1980's, the best business in the world were organisms to be found in Japan and, soon I discovered the secret of their success was their mastery of heterarchy". He showed that Japanese companies are characterized by the following: collective decision making, collective responsibility, informal and implicit control procedures, lifetime employment9, and evaluations promotions and slow, not specialized careers, global interest. By cons, US companies are characterized by: individual decisions making, individual responsibility, formal and explicit control procedures, short-term employment, rapid assessments and promotions, specialized careers limited interest (Ouchi, 1981).

3.9 The payoff rules, R9

3.9.1 Hierarchical implementation

In a hierarchical implementation, reward systems are classic or obsolete based on extrinsic motivators (carrot and stick).

3.9.2 Heterarchical implementation

The establishment of an incentive system within the group results in optimizing the success criteria, and developing strong participation and commitment within the organization.

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[9] Workers who have the status of "permanent employee" become members of the "community" that constitutes the company that hired them. They have a "job-based membership". This form of employment is very different from that which exists in other countries, namely the "employment-based workstation", where the tasks, the number of hours and the workplace are generally limited. In the Japanese employment system based on membership, employees do not have the right to refuse to perform tasks, work overtime or changing workplace (Hamaguchi, 2013).

Table 1 summarizes the types of rules set out according to the two visions.

The Rules	Hierarchical implementation	Heterarchical implementation
position (R1)	Fixed roles; Static Organization Chart.	Egalitarian and dynamic role (roles can be redefined); Action and thinking constantly on multiple levels.
Boundary (R2)	Unique access to the role; Competence limited to the role.	Access role multiple times; targeted and variable Competence; Multi level favoured.
authority (R3)	Dominant Authority; pyramidal distribution of authority; explicit and centralized control.	Collective and shared authority; dominance and subordination links are reversed and redistributed; tacit and distributed control.
information and knowledge (R4)	Withholding information (individualism); Centralized Information and compartmentalized; knowledge retention (individualism); Monopolizing Knowledge.	Information Exchange (collective spirit); Knowledge Sharing (collective spirit); Transparency and trust; Strong corporate culture; Problem-solving using network knowledge.
coordination (R5)	Coordination based on directives or standards (control mode); Vertical coordination between superior and subordinate (submission to orders).	Horizontal coordination through mutual adjustment; Strong relationship of interdependence between actors; Focus on common good.
decision (R6)	Personal responsibility on top; Decisions is limited to a certain category of actor.	Lateral Responsibility; Delegation of responsibility according to competence; Distributed Decision (several multi-level centres).
aggregation (R7)	Centralized Decision on top; Decision is limited to a certain category of actor.	Collaborative Decision, distributed and collegial (by most actors).
scope (R8)	Increased heteronomy multi level; Efficacy.	Increased empowerment at multiple levels; Strong responsiveness and agility; Reconciliation of decision making in place and time.
payoff (R9)	Classical individual rewards (selfishness).	Collective incentive system.

Table 1. *Summary of the type of rules in hierarchical and heterarchical implementations*

4   CONCLUSION

In this paper an Information Systems Governance has been approached as set of mechanisms and operating principles. They have been expressed as a system of rules, based on Elinor Ostrom's work. Actualized rules shape implemented governance.

The rules may be declined according to a conventional hierarchical vision of ISG, but heterarchical forms can also be introduced here or there. The first contribution is theoretical: beyond the view usually proposed by ISG repositories, IS governance can be expressed at a Meta level. It can be viewed as a political and regulatory arena, made up of rules which express a collective agreement within organizational players on how to control, to steer, to make decision, to assess the company's information system.Then, from a managerial point of view, a system of ISG rules may help CIOs ask the right questions: how to perform the exchange, collaboration, understanding of roles and responsibilities and the regulation of authority? It is a kind of handbook for CIOs who seek for more agility and decentralization within IS governance, but do not want to merely rely on emerging heterarchical forms.

A heterarchical implementation may lead to "*collective leadership*"[10] and ultimately harmonize CIOs' managerial practices. The framework helps questioning rules in use and their consistency. Lastly, at a methodological level, it provides guidance when analyzing an organization's ISG, and helps recognize some heterarchical forms. We have just started such an analysis in a large industrial company.

We have planned to extend the scope of investigation in order to consolidate types of rules, and maybe to find additional rules. Future research includes developing an auditing tool, whose functions could be to assess an organization's degree of heterarchy, to identify governance problems, and to suggest possible improvements.

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[10] William Ouchi showed that Japan's commitment based on democratic leadership leads to better quality, higher productivity and lower costs while making workers of different levels full partners in the business (Wilken, 2012). In other words, collective leadership will increase rather than decrease the cognitive demand placed on both leaders and team members (Michael and al., 2014). In contrast, the literature on shared leadership and self-management in work teams offers a different perspective on team functioning that suggests that hierarchical authority is not the only power structure in teams (Aime and al., 2014).

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