Specific knowledge, investment decision and organizational architecture

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Abstract : Within the theoretical framework of organizational architecture, this paper attempts to explain the decentralization of investment decision. To do so, it highlights the role of the allocation of decision rights and control as a factor explaining the effectiveness of investment management. Thus, the object of this research is, first, to strengthen the relevance of the theoretical corpus of Fama and Jensen (1983a, 1983b) and Jensen and Meckling (1992), and, secondly, to replicate the studies by Noda and Bower (1996), Fahmi (1999) and Catelin (2001) and extend them to the Tunisian context. The Tunisian example is relevant because of the lack of research on the topic for this country, and also because this research could improve decision making for investment in the current context of Tunisia. We show that the role played by organizational complexity, information and communication technology, training programs, and evaluation and incentive systems in the creation of value requires the setting of a centralized organizational structure. An empirical test was conducted on a sample of 63 Tunisian firms by using canonical analysis. This test allowed the validation of four out of the five tested hypotheses.

Key words: investment decision, organizational architecture (decisional rights, control system).

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The study of investment decision allows us to analyze some mechanisms for value creation by the firm, within the framework of an organizational approach taking into account the personal and historical factors, formal organization, information systems, control and reward systems. The investment decision, which represents one of the mechanisms that determine the performance of complex organizations[1], can be seen as a process within a firm where the various hierarchical levels, which arise at different phases of the process, can come into conflict[2]. This definition goes beyond the simple problematics of the optimal investment choices[3]. The investment decision must be defined much more broadly, if we want it to contribute significantly to the debate on the origin of the firm's performance and value creation. We define it as an organizational approach to the resources allocation of the firm. It is based on ex ante and ex post evaluation criteria of a quantitative and qualitative nature as well as on the decision process, and, more generally, on the elements permitting to explain the real behavior of organizations insofar as investment is concerned.

Participation of the investment decision in the maximization of the value created takes place primarily through a decentralized process[4], motivating and involving the hierarchical levels of the firm, holders of the specific knowledge, which is the basis of organizational efficiency[5].

Nevertheless, the decentralization of investment decision can also lead to organizational costs and destroy value. Its adoption involves the transfer of some decision rights to the Middle Management (MM) and Bottom Management (BM) who are informed and have knowledge relevant to decision making. But, only marginally bearing the monetary consequences of their investment decisions, these managers are not encouraged to act in the interests of the shareholders by maximizing the value of the firm. In addition to the agency costs that result from the conflicts of interest (Jensen and Meckling, 1976), the influence activities (Milgrom and Roberts, 1997) occur when the managers turn away from their work to influence the decisions of the firm. They represent in themselves the equivalent of rent-seeking behavior and emerge each time they come to making decisions affecting the

[1] A complex firm is characterized by a large diffusion of specific knowledge (expensive to transfer, Fama and Jensen, 1983a and 1983b; Demsetz 1988; Jensen and Meckling 1992; Zouari 2008, 2011, Fakhfakh et al. 2012) between many actors.

[2] According to Catelin (2001) and Zouari (2008), the investment process in a firm is defined through the role of three hierarchical levels namely: the top management of the firm, the middle management and the bottom management. According to the analysis by Fama and Jensen (1983a, b), the decision process breaks down into four sub-processes: "The initiative" is a cognitive process through which the "bottom management", by its nearer position to the market, possesses specific knowledge and proposes investment projects. Given the limited resources, these projects are in competition with each other. Then, they go back up the hierarchy in order to be approved (ratified) and controlled (monitored) by the middle management and / or top management. Next, they descend the hierarchy to be implemented by the "bottom management".

[3] According to Charreaux (2001), the neoclassical approach is a theory of valuation of investments during a stage of ratification in the investment decision. However, "investment behavior, as an object of investigation, is not limited to explaining selected investments alone, and it is unlikely that we can come to understand that choice without an explanatory theory of the investment process" (p.13). The questioning phase of the postulates of neoclassical theory (perfect rationality of agents, completeness of contracts, informational efficiency, separation of investment and financing decisions ...), considered as a non-theory of investment, allowed its enlargement and the emergence of theories focusing more attention on organizational aspects. This concern to explain investment decisions as they are in reality merely reiterated the conclusions reached by Bower in 1970.

[4] Decentralization is understood as the transfer of decisions rights to those holding the relevant knowledge (Jensen and Meckling, 1992). The decision and control functions (according to Fama and Jensen, 1983a) are separated and divided among several agents. An individual may be involved in the management function of certain investments and the control function of other investments, but the principle of separation means that they must not exercise the rights associated with two functions on the same investments. This decentralization should help to improve the efficiency of resource allocation (Park and Shen, 2008).

[5] Ghosh and Olsen (2009) show that the firm must manage and anticipate the data of an environment that is uncertain and international by leading a pertinent investment policy that is creative of value. The rapidity of its reactivity will enable it to improve, if not to preserve, its position in its sector of activity.

distribution of wealth or income among the stakeholders of the firm. The organizational costs incurred by the firm can degrade its effectiveness. The solution requires the adoption of an efficient organizational architecture[6]. According to the formulation of Brickley et al. (1997a, p.26), "... an efficient organizational architecture is an architecture which not only allocates decisional authority to individuals who possess specific knowledge, but also ensures that decision-makers are subject to the appropriate control system to take decisions that create value". The organizational architecture is constructed to minimize the organizational costs and enable individuals to make the most of the gains from cooperation, including the use of specific knowledge.

Thus, while recognizing the role of the decentralization of investment decision in value creation, Wruck and Jensen (1994) emphasize the difficulty of establishing a decentralized decisional structure. Fortunately, the theoretical and empirical studies have noted this difficulty. They have helped to explain the reasons for the improvement of organizational performance (Fahmi, 1999) and taken into account the important organizational aspects of a decentralization of the efficient investment decision (Noda and Bower 1996; Catelin 2001; Zouari 2008, 2011; Fakhfakh et al. 2012)[7].

So our research proposes, firstly, a strengthening of the theoretical corpus of Fama and Jensen (1983a, 1983b) and Jensen and Meckling (1992) concerning the decision process, and secondly, an extension and replication of studies by Noda and Bower (1996), Fahmi (1999) and Catelin (2001) in the Tunisian context.

Interest in the Tunisian firms finds its source in the absence of studies explaining investment decision decentralization and in the observation according to which these firms have undergone for some years a very strong competitive pressure that compels them to create value. This value creation, which has become their main preoccupation in a turbulent environment, operates mainly through the coherence and complementarity between the two dimensions of the organizational architecture of a firm (allocating decisional rights, performance measurement and incentive systems). This guarantees to these firms, which are engaged in a decentralized decisional structure, the participation and creativity of the different hierarchical levels, and hence, knowledge creation and value.

Section 2 is devoted to the development of an explanatory model of investment decision decentralization that takes into account organizational and environmental factors and the control system. Section 3 describes the methodological aspects of this study. Section 4 presents the analyses and empirical results.

Conceptual framework of the decentralization of investment decision

[6] The organizational architecture of a firm revolves around two main dimensions (Charreaux, 2005):
(1) Allocation of the decisional rights inside the organization. This allocation can cause a partition of decisional rights between "rights related to decision management", which include rights to initiate and execute the allocation of resources, and rights related to “decision control”, which concern the decisions ratification and monitoring. This distribution corresponds to the decision process (such as investment decisions) in organizations as it is previously represented by Fama and Jensen (1983a, b);
(2) Conception of the control system, distinguishing the performance measurement and evaluation system (individual, divisional and collective); and the incentive system that permits specification of the relation between the performance measurement and its consequences in terms of sanctions and rewards.

[7] The work of Noda and Bower (1996), Fahmi (1999) and Catelin (2001) established an organizational approach to investment decision that creates value. For more insight, refer to Zouari (2008).

In complex organizations where there is separation of the decision (initiative and implementation) and control functions (ratification and monitoring), the implementation of effective decision involves the co-location of relevant knowledge and the right decision. Hayek (1945) and Jensen and Meckling (1992) noted that the level of delegation of decision rights is the result of a arbitration between, on the one hand, the costs of transfer and treatment of specific knowledge, which increase with centralization and, on the other, the costs arising from agency conflicts (the cost of control loss) which increase with decentralization.

The multiplicity of the sources of knowledge and the difficulty of collecting that knowledge may make a centralized firm face a lack of data that is all the more embarrassing since the environment is uncertain. In this context, the unavailability of knowledge in making decisions is the central agent in incurring the risk of delayed reaction more knowledge is expected or if one cannot make effective decisions when one is content with the knowledge available. The costs of coordination and control brought about by decentralization will be offset by its benefits[8] in situations characterized by great uncertainty. Hence organizational complexity can influence the decentralization of investment decision. This variable is the common denominator of our hypothesis in this research.

The establishment of a system of decentralized decision is then explained by the constant need for specific knowledge and know-how on the past of the MM and BM in addressing the imbalances, distortions and dysfunctions. This need increases with organizational complexity. Indeed, the more the organization is complex, (1) the more the quantity of knowledge needed for investment decision making may be too large to be effectively treated centrally in a limited time, (2) the more the transfer of specific competences and knowledge implies very high costs, and (3) the higher the costs of coordination and communication.

In these circumstances, "if large firms do not find effective answers to these questions of information overload and organizational costs, their performance inevitably deteriorates. The best way to organize the activity of these firms is therefore to decentralize responsibilities rather than try to concentrate on a few individuals" (Fahmi, 1999, p.164). The diffusion of decision rights has the advantage of promoting better use of human knowledge by the firm. It can also be viewed as an alternative form of coordination and a means to reduce the flow of knowledge to be shared in the investment decision.

Thus, the establishment of a decentralized decisional structure is quite conceivable in complex firms (the case of large firms)[9] where it is likely that the benefits of coordination and decentralized work organization heavily prevail on the agency costs that inevitably result (Wruck and Jensen, 1994). According to the analysis by Jensen and Meckling (1992), the result of arbitration that determines the level of delegation varies with the size of the organization. "In general, when the size of a firm increases, the sum of the costs of the transfer and treatment of specific knowledge and costs associated with interest conflicts increases. When the marginal costs associated with the transfer and treatment of specific knowledge increase more rapidly with the size of the organization than the marginal costs of interest conflicts, the optimal level of decentralization increases with the firm's size" (p.264). These hypotheses were confirmed in the empirical study by Christie et al. (2003).

Therefore, in complex organizations, the Top Management (TM) delegates some decision rights, particularly in terms of investment, to middle and bottom managers holding specific knowledge that is too costly to transfer among agents, hence the following hypothesis:

[8] Value is generated through rapid and adequate treatment of local or specific knowledge held by the firm's actors.

[9] Note that organizational complexity has often been approximated by the variable size and the intensity of knowledge in the industry (Zouari, 2008, 2011).

H1: The degree of decentralization of the investment decision, from the top management of the firm to the middle and bottom management, is positively related to the organizational complexity of the firm.

Taking into account the information and communication technologies (ICTs) [10] has motivated changes at the level of decentralization through the rapid rise in technological innovation and cost reduction as well as in the time for transfer of knowledge which is central to local decision makers so that they may coordinate and increase the efficiency of decisions (Brickley et al. 1997a). These new technologies bring decentralization. "The importance of recent organizational changes (e.g. total quality management, reengineering,…) is partly the result of new information technologies that have changed the nature of work, including making knowledge and human capital the key factors of value creation" (Charreaux, 2000b, p.3).

Traditionally, the TM is connected at the BM to the MM who transmit the knowledge and instructions of the leadership and plays an important role in coordinating and monitoring the actions of the BM (Bower 1970; Burgelman 1983a, 1996; Noda and Bower 1996; Catelin 2001; Zouari 2008). Therefore, the new technologies, facilitating communication between the TM and BM, have reduced the use of the MM. These technological advances thus help (1) reduce the transmission time of the specific knowledge, (2) minimize the risk of distortion of knowledge by the MM and (3) facilitate communication between the top and bottom management.

Similarly, Jensen and Meckling (1992, p.264) argue that "Changes in information technology have an ambiguous impact on the optimal degree of decentralization. The direction of the effect depends on which information is most affected. When improved technology makes it easier to transfer specific knowledge effectively from lower to higher levels in the organization there will be a shift toward centralization. When improved technology makes it easier to transfer to lower levels in the organization information that formerly was specific to higher levels in the organization, there will be a shift toward decentralization".

According to Charreaux (2000b, p.3), "ICTs can make databases and tools available for decision support. They thus encourage decentralization and enhancement tasks, leaving more leverage for initiative. They may also have an effect on recentralization, either by facilitating recovery of information of a tacit character, or by putting tools in place to get them through other channels. Because of changes in the nature of the communication and information transmitted, we are seeing an increase in decisional delegation, particularly in terms of investment".

In this context, ICTs offer the opportunity to delegate decision rights, particularly in terms of investment, to middle and bottom managers because they make it accessible to them. They are useful knowledge to make a decision quickly and efficiently. Hence the following hypothesis:

H2: The degree of decentralization of the investment decision, from the top management of the firm to the middle and bottom management, is positively related to the existence and development of ICTs.

[10] ICTs cover all technologies and applications that simultaneously use the potential of data processing and telecommunications to store, treat and transmit data remotely (Molloy and Schwenk, 1995). As examples, we can mention email, video conferencing, management systems of databases, communication networks, etc.

The middle and bottom managers have general know-how, sometimes specific to the industry. They also develop knowledge applicable primarily in the restricted field of the firm. Thus, they make investments specific to the firm, which gives them a certain interest in influencing the firm's decisions (McNeil and Smythe 2009). The enhancement of such investments requires a certain evolution of the firm that is consistent with the appropriation of part of the organizational rents by middle and bottom managers (Aoki, 1980). Since the manager's discretion is limited by dependence on the resources provided by them, it can develop a set of implicit contracts in order to ensure their cooperation (Breton and Wintrobe 1982; Charreaux 1990) besides explicit contracts that are inadequate for protection against the opportunistic behavior of managers or mismanagement[11].

Leaders may delegate some decisional power to the units' managers to honor their implicit contracts, thus maximizing value creation (Treml and Lehn 2000; Xuan 2009), especially when the efforts of the middle and bottom managers, or when their skill[12] and qualification levels, are high (Mintzberg 1982; Connor 1992; Gibson et al. 1985).

One of the principles of decentralization is to allow the MM and BM some power to decide on investment and entice them to develop cooperative spirit, new qualifications, broader knowledge, detection and diagnosis of malfunctions, treatment and communication of knowledge, flexibility... The acquisition of these competences and abilities depends on "the existence of a training program[13]" (Wruck and Jensen, 1994, p.254) that is designed to familiarize the MM and BM with the environment of the firm (especially competitive) and its specificities in terms of processes, activities and organization, so they can make investment decisions enhancing the value of the firm.

The implementation of a decentralized decisional structure is generally dependent on a policy of investment in the training of MM and BM. "This training aims to teach these managers a methodology for scientific reasoning" (Wruck and Jensen, 1994, p.254). These managers they pose problems to be rigorously solved and approach methodical, creative value. "The goal is to develop their ability to efficiently analyze and treat knowledge and provide them with a set of tools and techniques for analyzing and solving problems" (Fahmi, 1999, p.187). The objective is to overcome the cognitive limitations of middle and bottom managers and encourage them to better use their personal abilities in the investment process, effectively utilize the time and resources of the firm, understand how to analyze complex situations and how to make a heuristic search for solutions to posed problems, select the relevant knowledge in a systematic and objective way, identify relevant factors in a given situation and create new ideas (Bowen and Lawler, 1992).

In this sense, the effectiveness of the decentralization of investment decision depends on the existence of training programs for middle and lower managers, hence the following hypothesis:

[11] Solutions such as co-management (Aoki, 1984), participation on the board or in joint ventures (Furubotn, 1988), financial participation (Desbrières, 1997a), employee ownership (Desbrières, 1997b) that allow solving the information asymmetry, are suggested.

[12] Competence is a "reservoir of applied knowledge, know-how, know-being, which allows the individual to do his job better. This competence is acquired and perfected through learning. The chain is presented as follows: data - information - knowledge - competence"(Mack, 1995, p.46).

[13] According to Boudes et al. (1997), the training program has many facets, ranging from very individualized processes and focussing on specific content (e.g. individual training on catalog towards a new accounting technique) to heavy programs, declining a new concept for managing the entire firm (e.g. collective inter-firm training on the setting up of a project-based organization or "total quality" program). These operations can be occasional or regular, interactive or not, voluntary (organized mechanisms) or not (through experience).

H3: The degree of decentralization of the investment decision, from the top management of the firm to the middle and bottom management, is positively related to the existence of a training program.

The coherence and complementarity of allocating decisional rights and control systems, which are the organizational game rules (Charreaux, 2000a), contribute to the efficiency of investment decision. To achieve this efficiency, the TM, delegating decision rights to some MM and BM, must organize a system of control (evaluation and incentive systems) aligning the interests of those actors with the firm, even though its conception and setting up are costly and cannot completely reduce the agency conflicts (Jensen and Meckling 1992; Brickley et al. 1997a, 1997b, 2003). This system helps specify the contractual conditions, measure results and ensure that the organizational objectives are achieved. It reduces the information asymmetry between superiors and subordinates and helps to reduce monitoring costs related to the decentralization of investment decision.

However, control of the investment decision taken by the TM using a single evaluation system (ex ante or ex post) poses the problem of control frequency (or periodicity)[14]. If the firm sets up a unique system of evaluation, it must meet one of two goals: It must either prevent the onset of the risks of overinvestment, the profusion of local initiatives (ex ante evaluation) or ensure the effectiveness of the implementation of investment projects (ex post evaluation). It is, however, very probable that the TM will not wait for the complete realization of an investment that involves significant resources of the firm to control the appropriateness of the choice of this investment.

The setting up of a double or a triple evaluation system can be a solution to this dilemma. According to Catelin (2001), controls should be more frequent and cover the choice of projects (ex ante control), the follow-up of their implementation (intermediate control) and the balance of investments (ex post control). The author found that the periodicity of follow-up in the realization of investment projects is mainly annual, and to a lesser extent, quarterly. In addition, individual evaluation can be carried out through the annual progress interview and collective evaluation, where it exists, is mainly done twice a year[15]. Similarly, De Bodt and Bouquin (2001, p.146) found that "ex ante, intermediate and ex post controls are carried out with annual frequency, which corresponds to the findings by Segelod (1995) with Swedish large groups ".

Furthermore, it is useful to consider the evaluation of middle and bottom managers, who have been delegated some decision rights, during and after the implementation of investment projects. This triple control often takes place annually. However, in the case of investment that hires important resources, evaluation may be done monthly or weekly. This frequency allows closer follow-up of the actions of the MM and BM in order to prevent risks that may be pre-contractual and post-contractual, and to follow the implementation of projects.

So, the ex ante only system, recommended in the financial-economic literature, has substituted a double system (ex ante and ex post) and a more frequent triple system (ex ante, intermediate and ex post). We deduce the following hypothesis:

[14] According to Milgrom and Roberts (1997), the frequency (or periodicity) of control mechanisms also concerns the evaluation of individuals. He/she constitutes an expensive activity, even if the person who is evaluating does not refrain from doing so because he/she implies to collection and to communication data, which takes considerable time and requires investment. However, the optimal frequency of evaluation creates a balance between its fixed costs which are considerable and the advantage of access to information for using it. Therefore, evaluations should be more frequent when they generate low cost and when the information that they produce modifies behavior.

[15] In his study, Catelin (2001) did not consider the periodicity of ex ante and ex post control systems.

H4: The degree of decentralization of the investment decision, from the top management of the firm to the middle and bottom management, is positively related to the control frequency (ex ante, intermediate and ex post)

Parallel to the definition of decision, control and performance measurement systems, the setting up of an incentive system is another way to ensure the effectiveness and efficiency of the decentralization of the investment decision by reducing the agency and influence costs (Jensen and Meckling 1992; Milgrom and Roberts 1997; Brickley et al. 1997a and b; Abernethy et al. 2004…). Incentives are envisaged in terms of non-monetary (promotion) or monetary (bonuses, stock options) rewards to increase the benefits associated with desired behavior[16]. However, monetary reward is by far the most important. This reflects the fact that "money represents a generalized right on the resources. People can then freely and easily replace non-monetary assets with money" (Duprat, 1998, p.173). It is therefore important to analyze the respective weight of individual and collective performance in the determination of monetary reward.

On the theoretical level, collective compensation generally relates to the entire organization and, somehow amounts to, systems of participation or interest in the results of the firm. The arguments advanced in favor of such collective systems can nevertheless be extended to units and / or teams. Three benefits are cited by Brickley et al. (1997a). First, it is sometimes difficult in a unit or group to measure, and thus to reward individual performance. Second, collective compensation is supposed to induce cooperative behavior, since one of the reasons for the formation of units or teams is looking for synergies and cooperation between different actors[17]. Finally, collective compensation can motivate employees to be monitored. Mutual monitoring is beneficial because specific knowledge about individual performance is often held by colleagues.

However, there are risks related to these collective compensation systems (which are also apparent in individual compensation). They are of three types (Milgrom and Roberts, 1997). First, the result is not always perfectly observable either because of its nature or because of the imperfection of the measurement system. Second, performance evaluation may include a greater or lesser degree of subjectivity on the part of the evaluator, making uncertain the measurement obtained. Finally, performance itself may depends on external factors beyond the control of the person evaluated. In compensation systems based on individual performance, the actions are evaluated individually and the results achieved are awarded to individuals involved in the action or project. Individual awards are then determined. The compensation system "encourages competition among employees and entices them to take considerable risks in order to increase their profits" (Fahmi, 1999, p.284). But this system can have disastrous consequences, "since it does not encourage the diffusion of knowledge to everyone. Moreover, it fosters rivalry and paralyzes cooperation between the individuals and / or units (teams) of the firm" (p.284).

Thus, in the context of the decentralization of decision rights, especially in terms of investment, individual incentives are not appropriate because individuals are not isolated and an efficient investment decision requires a certain level of cooperation. Collective incentives (unit or group) try to overcome the disadvantages of individual systems. These incentives can include "to promote cooperation and mutual monitoring, reduce influence activities, promote

[16] To study the impact of policies of promotion and compensation (bonuses and stock options) on the decentralization of investment decision, see Zouari (2008, 2011).

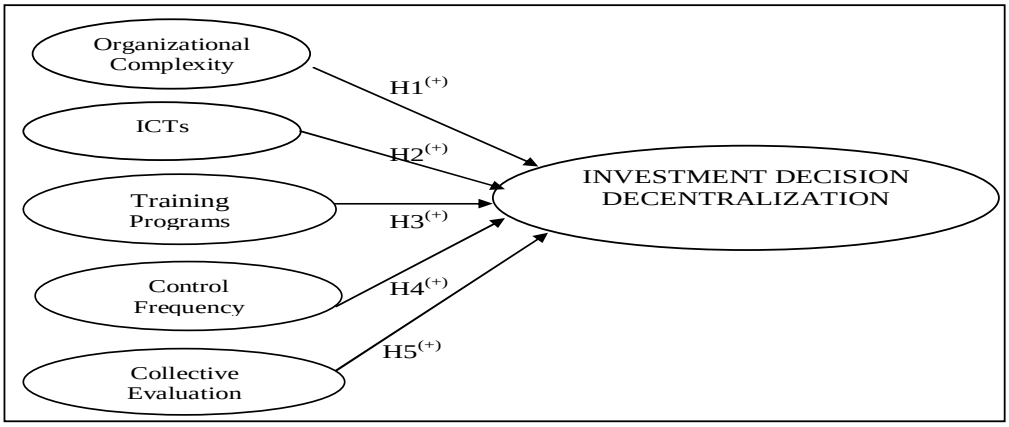
[17] Brickley et al. (1997a, p.314) recognize that the difficulty of measuring performance constitutes an obstacle to the development of individualized rewards, especially "when individuals work in teams because there are synergies and interdependencies between them".

the socialization of employees and align their interests with those of the firm" (Fahmi, 1999, p.293 -297). We deduce the following hypothesis:

H5: The degree of decentralization of the investment decision, from the top management of the firm to the middle and bottom management, is positively related to the existence of a collective incentive system for the unit (group).

As in the foregoing, and in the context of this study, we consider five variables that determine the decentralization of investment decisions: organizational complexity, ICTs, training programs, control frequency and collective evaluation. The theoretical predictions are presented in the figure n°1.

Figure n°1: The empirical model



Methodological aspects

Data were collected mainly by questionnaire[18]. The purpose was to collect information relative to the features of the decision and control systems, mainly relating to investment. To understand the theoretical links and collect exploitable questionnaires, it was necessary that our respondents should have sufficient knowledge of the subject and be able to provide all the data. That is why those responsible for decision-making centers (TM, MM and BM) constituted our target population[19]. The questionnaire was tested through five teachers and four professionals (a junior managing director, two the unit managers and a chief of project), then mailed to decision-making centers because of the geographical dispersion of the respondents.

Our investigation was conducted in 2007 from a file on firms elaborated by the Ministry of Industry and Energy (2007). In order to collect the maximum information on our subject, compare investments policies (in reference to the conceptual context) and increase the odds of getting firms exercising the centralization / decentralization of investment decision, it seemed more appropriate to study firms varying in size (their level of organizational complexity is different) and address the questionnaire to average firms (50 to 200 employees) and to bigger

[18] The questionnaire is available from the author.
[19] These are the decision makers who can be more sensitive to the organization of the investment process since every one of them possesses relatively important weight in one of the four stages of the process.

firms (more than 201 employees)[20]. Finally, we chose among the listed enterprises 270 average firms and 270 bigger firms, operating in various sectors of activity. In all, we collected 63 questionnaires for statistical analysis, with a rate of return of 11.6%. Average and big firms represent, respectively, 5.92% (32 over 540 firms) and 5.74% (31 over 540 firms) of the total population. The characteristics of the distribution of both types of firms relative to size as measured by the number and amount of sales are very similar (see Table 1).

A large number of respondents belong to the category of "middle managers" (39 over 63 were interviewed: a rate of 61.9%, see Table 2). They occupy the following posts: administrative and finance manager, finance manager, sales manager, accounting manager, marketing manager, management and organization controller, unit manager and technical manager. The general managers and CEO's have a response rate of about 34.9% of the final sample. Finally, the new project managers have responded to two questionnaires (3.2%). The existence of two broad categories of respondents can be explained by the role and interest of, on the one hand, operational investment management by the MM and, on the other, strategic investment management by the TM.

Table 1 - Characteristics of average and bigger firms

	Number of firms	Number of employees					Turnover in thousand Tunisian Dinars				
		Mean	Median	Standard deviation	Minimum	Maximum	Mean	Median	Standard deviation	Minimum	Maximum
Average firms	31	99.5	90	43	50	189	4 276	1 650	5 603	500	26 700
Bigger firms	32	564	450	404	203	2058	35 000	20 000	38 000	3 800	170 000
All firms	63	238	189	367	50	2058	19 000	6 500	31 000	500	170 000

Table 2: Current posts of the respondents

Posts		
- CEO's	2	
- General managers	20	
Total	**22**	**34.9%**
- Administrative and finance manager	4	
- Finance manager	14	
- Sales manager	2	
- Accounting manager	5	
- Marketing manager	1	
- Management and organization controller	8	
- Unit manager	3	
- Technical manager	2	
Total	**39**	**61.9%**
- New project managers	2	
Total	2	3.2%
Total	**63**	**100%**

[20] Managers of small firms - 10 to 50 employees - feel less concerned by the problematics of our research, which they perceive as unhelpful in making theoretical plausibility more interesting.

Measurements of the variables of the model are contained in Table 3. One major problem we had in our work was the paucity of empirical studies on the subject (with the exception of those of Noda and Bower 1996; Catelin 2001). To find the measuring indicators for the study variables and to identify the measurements most frequently used and widely available, we relied on the key indicators encountered in the literature and in the pre-survey[21]. All the variables led to a purification work done during an iterative process, with the exception of organizational complexity. We will recall here the measurements adopted for the variable of investment decision decentralization.

For a description of the degree of investment decision decentralization of the firms studied, we relied on the work of Catelin (2001, 4 dimensions and 23 items) and the indicators analyzed by Kalika (1995) and Messeghem (1999) in their studies on the efficiency of organizational structures. On the other hand, we formulated the items for the identification of the steps of decision making and control within the organization as defined by Fama and Jensen (1983a, b). These criteria and the theoretical literature established the framework for the development of our own measurement of investment decision decentralization. We thus developed a set of 26 items measured by the attitude scales of the Likert type. After iterations made on the basis of the Principal Components Analysis (PCA) and the Varimax rotation [22] and reliability testing, these 26 items were reduced to 12 items and summarized in 5 factors measuring the investment decision decentralization:

- monitoring and ratification of all the projects by the MM
- ratification of all the projects by the TM
- implementation of the projects by the BM
- monitoring of all the projects by the TM
- degree of autonomy in proposing the projects.

The explanatory variables influence the decentralization of investment decisions and verify its multidimensionality. They are also distinct from each other and present, as shown in Table 4, a low and/or insignificant correlation between them.

To test the model, we use 1994-2000 STATISTICA as a method for multivariate analysis. Every relationship has been tested independently by using canonical analysis (when the relationship is composed of several explained variables). This "second generation approach" helps to determine whether there is a significant relationship between the decentralization of investment decisions, on the one hand, and the organizational factors, performance measurement and incentives systems, on the other. Every relationship has been tested independently[23].

[21] For more on the development phase of the variables measurements, see Zouari (2008).

[22] The PCA aims to summarize information, by replacing the original items by a smaller number of composite variables, and test the reliability of these composite variables. The results of the PCA are available from the author.

[23] For further study of this statistical method, refer to Zouari (2008).

Table 3: Measurements of Explanatory Variables in the Model of Investment Decision Decentralization

PCA No	**Initial variable**	**Measurements or Factors Extracted**
1	- The Degree of Decentralization of the Investment Decision	Likert scale to 5 points and 26 items, after PCA with Varimax rotation: 5 factors: - Monitoring and Ratification of all the projects by the MM - Ratification of all the projects by the TM - Implementation of the projects by the BM - Monitoring of all the projects by the TM - Degree of autonomy in proposing the projects
2	- Existence of Information and Communication Technologies	Likert scale to 5 points and 5 items, after PCA with Varimax rotation: 1 factor: - Existence of ICTs
3	- Training Programs	Likert scale to 5 points and 3 items, after PCA with Varimax rotation: 1 factor: - Training programs
4	- Control Frequency	Likert scale to 5 points and 6 items, after PCA with Varimax rotation: 2 factors: - Systematic procedures of control and information - Periodicity of control
5	- Collective Performance Measurements	Likert scale to 5 points and 3 items, after PCA with Varimax rotation: 1 factor: - Collective evaluation of the firm's personnel

Table 4: Correlations Matrix

	Activity Sector	Employees Number Log	ICTs	Training Programs	Systematic procedures of Control and Information	Periodicity of Control	Collective Evaluation
Activity Sector	1.00						
Employees Number Log	0.15 (0.241)	1.00					
ICTs	0.03	0.26 (0.165)	1.00				
Training Programs	0.07	-0.27 (0.162)	0.09	1.00			
Systematic procedures of Control and Information	0.11	0.38 (0.125)	-0.22 (0.176)	-0.14	1.00		
Periodicity of Control	-0.03	-0.09	0.06	-0.04	0.00	1.00	
Collective Evaluation	0.09	-0.10	0.16 (0.235)	0.15 (0.241)	-0.07	-0.04	1.00

1) Note that all correlations between variables are significantly smaller than 0.6 (threshold at which we begin to experience serious problems of multi-colinearity). In the Pearson test and the index of conditioning we have found that these variables are distinct from each other and are not significant (correlation thresholds above 10% and the packaging is less than 1000).

Presentation and interpretation of results

This section presents the test results of five assumptions underlying the explanatory model of the decentralization of investment decision.

The values in Table 5 are indicators of the overall link between the degree of investment decision decentralization and independent variables (determinants). Calculation gave only one significant canonical pair at 1% or 10%.

Information on the correlation coefficients of the significant canonical axis pairs appears in Table 6. This table replicates the factor structure of the significant canonical pairs, that is to say, the correlations between the synthetic variables from the PCA and the canonical axes. We indicated in bold the weights with a value significantly greater than 0.5 (generally accepted threshold, Evrard et al. 2003; Zouari 2008; Zouari-Hadiji and Zouari 2010a, 2010b; Fakhfakh et al. 2012).

Table 5 - Canonical correlations results

Hypotheses	Pairs of canonical axes	R canonical	R^2	Chi^2	Threshold significance	Index of redundancy
H1	1	**0.4241**	**0.1799**	**18.237***	0.0511	**0.0359**
	2	0.3310	0.1095	6.732	0.1507	0.0219
						0.0578
H2	1	**0.3888**	**0.1511**	**9.5881***	**0.0878**	**0.0302**
H3	1	**0.5543**	**0.3073**	**21.4798*****	**0.0006**	**0.0614**
H4	1	**0.6003**	**0.3604**	**26.898*****	0.0027	**0.0720**
	2	0.1292	0.0167	0.977	0.9131	0.0033
						0.0753
H5	1	0.3867	0.1496	15.818	0.1050	0.0299
	2	0.3236	0.1047	6.419	0.1699	0.0209
						0.0508

(Thresholds: *** significant at 1 %, ** significant at 5 %, * significant at 10 %)

Table 6- Factor structure of significant canonical pairs

Hyp.	Variables		Axis 1
H1	Explained variables	- F1. Monitoring and Ratification of all the projects by the MM	0.3852
		- F2. Ratification of all the projects by the TM	**0.8656**
		- F3. Implementation of the projects by the BM	0.1678
		- F4. Monitoring of all the projects by the TM	-0.2703
		- F5. Degree of autonomy in proposing the projects	-0.0328
	Explanatory variables	- The specific knowledge intensity	-0.4526
		- Employees number Log	**0.7314**
H2	Explained variables	- F1. Monitoring and Ratification of all the projects by the MM	0.3408
		- F2. Ratification of all the projects by the TM	-0.1296
		- F3. Implementation of the projects by the BM	**0.5781**
		- F4. Monitoring of all the projects by the TM	-0.0607
		- F5. Degree of autonomy in proposing the projects	**-0.7273**
	Explanatory variable	- Existence of ICTs	**-1.0000**
H3	Explained variables	- F1. Monitoring and Ratification of all the projects by the MM	0.4512
		- F2. Ratification of all the projects by the TM	**0.5981**
		- F3. Implementation of the projects by the BM	0.4967
		- F4. Monitoring of all the projects by the TM	0.3389
		- F5. Degree of autonomy in proposing the projects	0.2775
	Explanatory variable	- Existence of a training programs	**-1.0000**
H4	Explained variables	- F1. Monitoring and Ratification of all the projects by the MM	-0.2121
		- F2. Ratification of all the projects by the TM	-0.3552
		- F3. Implementation of the projects by the BM	**-0.6666**
		- F4. Monitoring of all the projects by the TM	-0.4403
		- F5. Degree of autonomy in proposing the projects	0.4363
	Explanatory variables	- Systematic procedures of control and information	**-0.9842**
		- Periodicity of control	0.1768

Organizational factors

The calculations revealed a single significant canonical pair at 10% (see Table 5). The first canonical correlation coefficient (R Canonical) is about 0.42 and reflects the existence of a linear relationship between the two groups of variables. This correlation, significantly, expressed only 18% of the common variance (R^2), that is to say of the variance of the investment decision decentralization explained by the organizational complexity.

Moreover, the index of total redundancy[24] is 5.78%, with the first significant relationship representing 62.1% (that is, 3.59% over 5.78%). We can therefore conclude that the two sets of variables share a middle portion of the total variance[25] (Fornell and Larcker 1980), and that the explanatory power of organizational complexity is moderately reliable (Thompson, 1990).

One of the two variables measuring the organizational complexity (employees number log) is positively related to the canonical axis (r = 0.73), and the one measuring the degree of investment decision decentralization ("Ratification of all the projects by the TM) is positively correlated to it (r = 0.86, see Table 6). Thus, complexity seems to be a key organizational

[24] The indicator of redundancy allows us to appreciate the part of the variance of each set of variables explained by canonical axes.

[25] Fornell and Larcker (1980) consider that redundancy is important when it exceeds 10%, average when it is located between 5 and 10%, and weak when its value is less than 5%.

factor when we analyze the investment decision decentralization. Indeed, the more the organization is complex (in our study, the larger the size of the firm), the more ratification of the projects is carried out by the TM. The complexity factor (significant at 10%) then helps to explain the decentralization degree of the investment decision but in the opposite direction to what is expected. These results lead us to **disprove hypothesis H1**.

The setting up of a decentralized structure is not economically viable in big Tunisian firms which are characterized by low informational issues, and where a high degree of centralization will lead to optimal decision making. In these firms, it is likely that the benefits of the coordination and organization of work within the framework of a decentralized policy do not outweigh the agency costs that inevitably result.

The test of hypothesis **H2** gave a single significant canonical pair (at 10%, see Table 5). The canonical correlation coefficient is 0.38. But this correlation, significantly, expressed only 15.1% of the common variance. Moreover, the index of total redundancy is about 3% (less than 5%, criterion of Fornell and Larcker, 1980). The two groups of variables, therefore, share a small portion of the total variance and the relationship between them is unreliable and inadequate.

The variable "ICTs" is negatively related to the canonical axis (r = -1.00), while two of the five measurement of the degree of investment decision decentralization ("Implementation of the projects by the BM" and "Degree of autonomy in proposing the projects") are positively and negatively correlated to it, respectively (r = 0.57, r = -0.72).

These results show the existence of a bipolar relationship (Evrard et al. 2003; Liquet et al. 2003; Zouari 2008) by contrasting the extracted factors (F3 and F5). Unless the measurements of the variable "decentralization of investment decisions" are inappropriate, it seems that the less the organization seeks to set up ICTs, the more it favors increasing the autonomy of the MM and BM in proposing the projects, consistently with our hypothesis. However, contrary to our expectations, it appears that the less the organization seeks to develop new ICTs, the more it promotes greater freedom for the BM in the implementation of the projects.

But as the weight of the canonical "degree of autonomy in proposing the projects" is higher than that of the "Implementation of the projects by the BM" (0.72 against 0.57 in absolute value) [26], the variability of the decentralization of investment decision is essentially the "degree of autonomy in proposing the projects". **Hypothesis H2** is **validated**. ICTs facilitate when there is delegation of initiative rights to middle and bottom levels of the hierarchy.

The results of the testing of hypothesis **H3** revealed a single significant canonical pair at 1% (see Table 5). The canonical correlation coefficient is about 0.55 and represents nearly 31% of the common variance. The index of total redundancy is 6.1% (between 5 and 10%, Fornell and Larcker criterion, 1980) and reflects the existence of an average linear relationship between the "decentralization of investment decision" and "training program".

In Table 6, we note a link between "training program" (canonical coefficient r = -1.00) and one of the five measurements of the degree of investment decision decentralization ("Ratification of all the projects by the TM", whose coefficient value is r = 0.59). These results show that the setting up of a training program for firm's personnel reduces the ex ante control of the investment projects by the TM. Accordingly, the degree of investment decision decentralization would be positively correlated with the existence of a training program. This result leads us to **validate hypothesis H3**.

One of the principles of the decentralization of investment decision is delegated to the MM an ex ante control rights to encourage them to acquire new competences and abilities in

[26] By choosing the largest absolute values of correlation, it is possible to establish associations between explained and explanatory variables (Evrard et al. 2003; Zouari 2008).

detecting and diagnosing malfunctions... Such acquisition depends on the existence of a training program.

The control system

The calculations made to test hypothesis **H4** gave a single significant canonical pair at 1% (see Table 5). The first canonical correlation coefficient is 0.60 and indicates the existence of a linear relationship between the two groups of variables. This correlation, significantly, expressed 36% of the common variance, that is to say of the variance of the decentralization of investment decision explained by the control frequency.

Moreover, the index of total redundancy is 7.5% (between 5 and 10%, Fornell and Larcker criterion, 1980), with the first significant relationship representing 95%. Our explanation of the decentralization of investment decision by the second variable (control frequency) is moderately reliable and adequate (Thompson, 1990).

The variable measuring the control frequency (that is to say, "systematic procedures of control and information by the TM) is negatively correlated with the canonical axis ($r = -0.98$); and the measuring degree of investment decision decentralization ("implementation of the projects by the BM") is also negatively correlated to it ($r = -0.66$, see Table 6). The values of these correlation coefficients show that the decentralization of the implementation of investment projects is adopted by the Tunisian firms putting in place more frequent controls (ex ante, intermediate and ex post). **Hypothesis H4** is **confirmed**.

For hypothesis **H5**, we showed that the degree of investment decision decentralization depends on the collective performance measurements which allow overcoming the disadvantages of individual evaluations by promoting cooperation and mutual monitoring and reducing influence activities. However, calculations yielded no significant canonical pair (see Table 5). There is no linear relationship between the two groups of variables. The decentralization degree of the investment decision would not be linked, at least in a linear manner, to the setting up of a collective performance evaluation. **Hypothesis H5** is **not validated** by canonical analysis.

In summary, canonical analysis reveals four significant linear relationships among the five tested: three are validated and one is overruled. These results are very interesting because they partly determine the existence of interdependence and complementarity between the two pillars of the organizational architecture (allocation of decision rights, performance measurement and incentive systems) and the contingent factors, according to theory, and therefore, the acceptance of the theoretical model explaining the investment decision decentralization. Relations that underlie this model are, in part, linear and significant.

This partial challenge to the linearity of relationships may be explained by the fact that Tunisian firms are in transition and evolve in a volatile and uncertain environment. They are therefore forced to adapt, not regularly and continuously, but in a way that allows them to be rapidly responsive and proactive in unforeseen situations in order to ensure their development and sustainability.

Therefore, this work and the ensuing results have enabled us to better understand and explain the decentralization of investment decision in Tunisian firms and its determinants (organizational variables, evaluation systems and incentive). They have also permitted us to understand the lack of stable statistical links between the two groups of variables in the model.

These results are relevant both from a scientific perspective and for the conduct of firms and policy options in favour of investment decisions decentralization. Aware of its advantages,

Tunisian managers have adopted decentralization as a means to promote good governance and of development at the base, and to institute higher levels at the lower levels of the hierarchy. Investment projects are no longer just at the top of the hierarchy, but are delegated to the middle and bottom managers. Parallel to this delegation, the TM puts in place the appropriate control system over the behavior of individuals, which is a key success factor for the establishment of a decentralized structure. Although the delegation of authority to those who have the necessary information to make effective decisions is a determinant of value creation, it is only useful when the new decision makers are frequently controlled and enticed to share the objectives of the firm.

CONCLUSION

The study of the decentralization of investment decision seems interesting not only because it tells about how the corporate decision processes, but also because it allows us to better understand the mechanisms of value creation. Taking into account the benefits of the decentralization of investment decision and the resulting cost enriches our analysis of this new organizational form. The Tunisian example is relevant, first because of the lack of research on the topic for this country, and secondly because this kind of research can improve investment decision making in the current context of Tunisia.

In the explanatory model of the decentralization of investment decision, we hoped to verify five fundamental hypotheses on Tunisian firms, according to which the organizational variables and control systems condition the adoption of investment decision decentralization. The relevance of this model has been demonstrated.

Even if the organizational complexity has a linear and negative impact (opposite sign to what is expected) on the decentralization of investment decision which creates value, it appears that there is a positive linear association with the existence of ICTs, training programs, and control frequency. These findings reinforce the theoretical corpus of Fama and Jensen (1983a, 1983b) and Jensen and Meckling (1992) concerning the decision process and partly corroborate those by Noda and Bower (1996) in the American context and Fahmi (1999) and Catelin (2001) in the French context.

If this work has enabled us to confirm and clarify certain deductions from the theory of organizational architecture, it also paves the way for future research. To assess the overall validity of the model, it is necessary to test the complementarity and coherence mechanisms constituting the organizational architecture, as well as the model itself longitudinally.

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