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# SYSTEMIC APPROACH AS A MULTI-CRITERIA DESIGN METHOD: HEALTHCARE R&D CENTRE APPLICATION

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## ABSTRACT

In today's very competitive and changing environment, developing a competitive advantage is a huge challenge for companies. But it is not their single challenge. They have to be different from and always better than the others on a lot of criteria. Companies' performance has become multi-criteria; the performance can be for example scientific, societal, ethical or economical performance. In this context, companies that plan to create a new organisation or department have to think ahead all these strategic objectives to fulfil. This article presents a systemic approach for the multi-criteria design of a research centre, MIR*Cen* (Molecular Imaging Research Centre).

MIR*Cen* is a research centre developed by the CEA (Commissariat à l'Energie Atomique) on preclinical imaging dedicated to gene, cell and drug therapies. Its main objective is to facilitate and accelerate new drug and new therapies creation and development thanks to the gathering on a single geographical site of technological skills, medical skills and industrial network. The general objective of this research is to design, anticipate and improve the management of such a pole of competence, especially in terms of costs and creation of values (such as scientific, environmental, social or ethical values).

Our systemic approach, called SCOS'D (Systemics for Complex Organisational Systems' Design), is used to design this new organisational system to meet in the best possible way the expectations of all stakeholders. This paper presents the different possible perspectives of the proposed method too, for example performance measurement and control, quality management or costs/values balance, through the tool SCOS'C² (Systemics for Complex Organisational Systems' Command and Control).

*Keywords: Systemic approach, multi-criteria design, modelling, research and development, organisation theory, health services*

## 1 INTRODUCTION

In July 2005, through the labelling of 66 "pôles de compétitivité" (the French equivalent of "clusters"), the French government formalised the creation of synergies between companies, research units and education centres on specific geographical areas. This political choice aims at facing the evolution of the competitive environment. Today, companies have not only to well control their costs in order to develop a competitive advantage, but other performance criteria have appeared since the 1990's, such as environmental, ethical, social or scientific criteria. Moreover in today's very instable economic environment, companies have to adapt their production and their organisation to the very changing needs of their customers. As Peter Drucker underlines [1], companies cannot design stable organisational structures anymore: in order to stay competitive, they have to be agile and flexible. Project and network managements have appeared recently to enable companies to adapt their structural organisation to their environment. Those management practices designed for short periods are thus temporary. And temporary organisations are not satisfactory in terms of transmission, sharing and perpetuation of knowledge. Many authors deal with this knowledge transfer problem within project-oriented organisations in particular [2] [3] [4] [5]. We can wonder whether organisation structures that would be both long term and flexible could be designed. This question is an operational issue for companies in developed countries. These new ideal organisation structures have to take into account the expectations of all stakeholders of the organisation. As Peter Drucker specifies [6], "*the*

*organisation must "be sold" to its members – employees, volunteers or connections – as much, and perhaps more carefully, as it sells its products and services. It has to attract people, retain them, appreciate them and gratify them, motivate them, serve them and satisfy them*."

Systemic approaches are today used for the design of products or services in order to take into account the changing expectations of the customers. The classical modelling methods are the preceding model method (reasoning by analogy) and the analytical method (cause and effect relations) [7]. The systemic approach is opposed to the analytic method, which decomposes the reality into more and more little units and analyses the linear causalities that link these units, running the risk of destruction of any possibility of reconstruction of the whole [8]. These systemic approaches used to design products or services could inspire approaches and methodologies to design organisational structures. Leaning on systemics means having tools and tested principles of modelling when we face complex phenomena such as decision [9] or knowledge [10]. This approach also makes it possible to develop the concept of point of view (organisation, process, structure) on a phenomenon.

In order to experiment the relevance of such a systemic method to design organisations, we have conducted a case study on a research centre. MIR*Cen* (Molecular Imaging Research Centre) is an integrated research centre developed by the CEA (Commissariat à l'Energie Atomique: French Atomic Energy Commission) on preclinical imaging dedicated to gene, cell and drug therapies. This centre is planed to open at the beginning of the year 2008 in Fontenay-aux-Roses (92 – FRANCE). Its main objective is to facilitate and accelerate new drugs and new therapies creation and development thanks to the gathering on a single geographical site of technological skills, medical skills and industrial network. This centre belongs to the "pôle de compétitivité" Medicen Paris Region. Its strategic drivers are scientific excellence, innovation at all levels and transversal research. The general objective of our study is to design, anticipate and improve such a pole of competence, especially in terms of creation of values. Through this study, the CEA aims at reconciling best preclinical research, new technologies and the needs of the biomedical and pharmaceutical companies. The systemic approach can be used to design new organisational systems to meet in the best possible way the expectations of the stakeholders. This method can be combined with other usual methods in order to design the organisational structure of MIR*Cen* with an objective of global values criteria.

In the second part of this article, some design methods are described with their particularities and their lacks; then the systemic approach is introduced as a possible multi-criteria design method. The third part describes the principles of the proposed approach and the case of study MIR*Cen*. The steps of the design process and its possible perspectives are presented in the fourth and last part, for example performance measurement, quality management or costs / values piloting.

## 2 SYSTEMIC APPROACHES AND THE DESIGN OF ORGANISATIONS

The performance criteria, the company's values, are multiple and evolve through time. The design methods based on these values enable the companies to adapt themselves to them. Few multi-criteria design methods exist. The enhancement of the complexity of performance and design criteria reveals the limits of the existing tools. The systemic approach, particularly adapted to the study of complex objects, can inspire new ways of organisations design.

### 2.1 The multiple types of values

Performance is the essential motivation of all companies. In the past it was formulated only in terms of profitability (financial performance); today it is expressed not only as a function of the cost, as in the Taylorist period, but also as a function of other criteria like quality, deadline, innovation, etc. [11] [12]. The purely financial performance representation is more and more contested [13]. In addition companies are perpetually on the lookout for the improvement of this performance.

This evolution of the performance is placed in the evolution of the markets context, in particular the inversion of the offer and demand ratio, classically described in three phases [14] [15]:

- 1945 - 1975: the demand exceeds the offer; the performance is mono-criterion, focused on the costs;
- 1975 - End of the 1980's: the offer balances the demand, then exceeds it; the performance becomes multi-criteria [16], centred on quality, cost and deadline;
- Beginning of the 1990's - Today: the offer is very upper than the demand; performance criteria are becoming more numerous with new aspects as marketing, communication, innovation, personalisation, after sales service, etc.

These last years, a new criterion is added to these criteria appeared in the 1990's: it is the matter of the renewal of the Corporate Social Responsibility movement [17], which brings over another type of performance: the social, societal, ethical and environmental performance.
The multi-criteria aspect of the performance goes hand in hand with the multidimensional aspect of value: then we speak about values (like social, economical or ethical). These one represent so the financial value but also the image, the competencies, the knowledge capitalisation, the technologies or the innovation for example. They have to satisfy the whole stakeholders of the company, like the employees, the shareholders, the customers, the suppliers, the partners and the societal environment.
The evolution of the context and the matter given to sustainable development drive companies having to command and control a multi-criteria performance (that is productivity, flexibility, costs, deadlines, quality, security, social performances or environmental performances) on the whole products life cycle (design, production, use, destruction/recycling). This evolution of the performance criteria leads to a reconsideration of the organisations design methods.

### 2.2 The lack of multi-criteria design methods

The existent theories, methods and tools do not meet today companies' operational needs. Indeed many multi-criteria analysis methods exist but there are few multi-criteria design methods for organisations. Moreover there are few organisations design methods. Products design methods, like design to cost, design for manufacturing or design for X, could perhaps inspire organisational design methods. But there are few researches about this subject.

### 2.3 Systemic approach and organisations design

System dynamics analysis can be used to design organisations. An organisational structure constitutes in essence a complex system. Jean-Louis Le Moigne [7] synthesises a General System description as "*an object which, in an environment, equipped with finalities, carries out an activity and sees its intern structure evolving through time, without losing its own identity*" (cf. Figure 1).

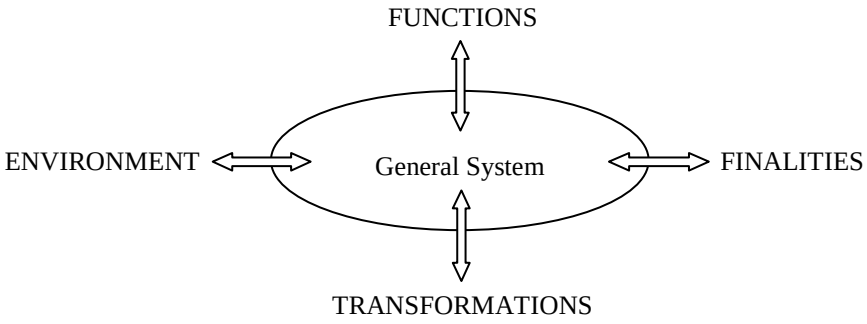


*Figure 1. Canonical model of the General System (Source: extracted from [7])*

In order to design new organisational structures, the finality, that is the objective (to create an organisational structure which produces values and balances its budgets for example), guides the design step which makes the new structure parameters evolve (like its means, its operating modes, its growth mode and its finalities). This single entity does not lose its identity of engineering and design department (of design office). Paraphrasing Le Moigne, the organisational structure design system can be defined as the structure (engineering and design office or project team for example) which, in the environment (that is the company and its scientific policy), equipped with finalities (such as working out an organisational structure and equipping the country with new means), carries out a design activity and sees its intern structure (that is human, financial, informational and technical resources) evolving through time (such as feasibility study, pilot study, study or launching), without losing its structure identity (engineering and design office). The systemic approach enables to contribute to the design of new organisations. Indeed, it initially requires to isolate the system without forgetting its relations with its environment, and thus to distinguish what the design field is from what it is not, or from what interface is. It also requires distinguishing what the system to be designed is from what it is not, or from what its interfaces are. As these systems (design system, produced system) go through the phases of their respective life cycle, characterising these phases results in considering for each phase the specific needs of its stakeholders (such as shareholders, employees or suppliers). This kind of

requirements engineering allows a robust expression of needs for the engineering and design department that produces the system as well as for the system to be designed. Then the robustness of the requirements makes it possible to work out the processes which will carry out these requirements. These processes are directly worked out to meet the expected requirements and thus to create the strictly necessary (and why not sufficient) added value.

# 3 SYSTEMIC ANALYSIS AS A MULTI-CRITERIA DESIGN METHOD: FROM THE SYSTEMS TO THE PROCESSES AND RESOURCES

The systemic approach is a systematic method which can be used to contribute to the design process. The general principle consists in starting from the laid down strategic objectives and the expectations of the stakeholders in order to set up the processes that are necessary to answer them as well as possible. The first step is to define the considered system and decompose it into sub-systems if necessary. When the boundaries of the system are delimited, the phases of the life cycle of this system have to be clarified. For each of these phases, the stakeholders and their expectations can then be listed. Finally, the processes which answer them can thus be set up (Part 4).

This part aims at presenting the proposed method (Paragraph 3.1) and at presenting the case of study (Paragraph 3.2). The systems and phases decomposition is then applied to this case (Paragraph 3.3).

## 3.1 The SCOS'D method (Systemics for Complex Organisational Systems' Design)

Every industrial system is composed of the same main elements, or almost. Jean-Louis Le Moigne [7] proposes a modelling prototype of the articulation of a complex system in nine levels:

1. The phenomenon is identifiable,
2. The phenomenon is active: it "makes",
3. The phenomenon is controlled,
4. The phenomenon is informed on its own behaviour,
5. The system decides on its behaviour,
6. The system memorises,
7. The system coordinates its decisions of action,
8. The system imagines and conceives new possible decisions,
9. The system is finalised.

The first systemic decomposition of the enterprise system is the canonical model O.I.D. (Operating system / Information system / Decision System) of Jean-Louis Le Moigne [7] (cf. Figure 2).

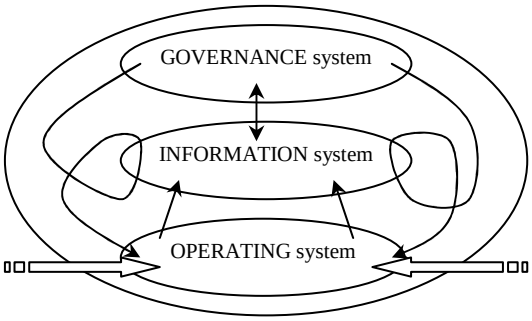


*Figure 2. Canonical model O.I.D. (Source: extracted from [7])*

This decomposition, classical in system sciences, can be decomposed to a lower level. Jean-Louis Le Moigne [7] proposes such a sub-decomposition for the decision system. Sylvain Perron [18] proposes such a sub-decomposition for the operating system.

Each system and sub-system is composed of several phases all along its life cycle [18]. A generic representation of theses phases may be the one drawn on Figure 3.

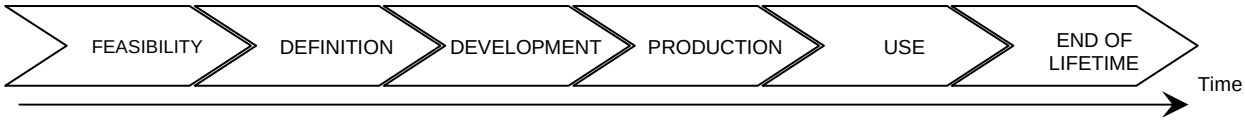


*Figure 3. Phases of an industrial system (Source: extracted from [18])*

The systemic approach is opposed to the analytical method, which breaks up reality into as many small units and analyses linear causalities which bind these units, running the risk of destruction of any possibility of rebuilding of the whole [8]. It makes it possible to adopt an overall step in order to describe the creation of values as a whole. The general principle of the employed systemic approach is to leave from the laid down strategic objectives and expectations of the stakeholders of the company in order to determine the processes necessary to answer it as well as possible and then to evaluate the values created through these processes. The stakeholders represent here the whole of the "people" who are concerned in a way or another by the good walk of the considered company, for example in terms of finance (shareholders), remuneration and wellbeing (employees), scientific projection (scientific community) or work and environmental impact (company, mankind), without forgetting utility, returned service (final customers). All these stakeholders do not expect the same things of the considered system, even expect incompatible things between themselves. They thus do not perceive the same created values.

The systemic approach we propose in this article, called SCOS'D (Systemics for Complex Organisational Systems' Design), is a method which enables us to integrate the different aspects of the stakeholders' demands (such as sustainable development, environment protection, safety, hygiene, ethics or working conditions). The general developed method can be represented as Figure 4. The researched values are clarified for each phase of the life cycle and for each customer at the beginning of the general process, so that all creating values processes are developed to meet this search. It becomes "easy" to establish a feedback to control the efficiency of the processes. The processes are under control.

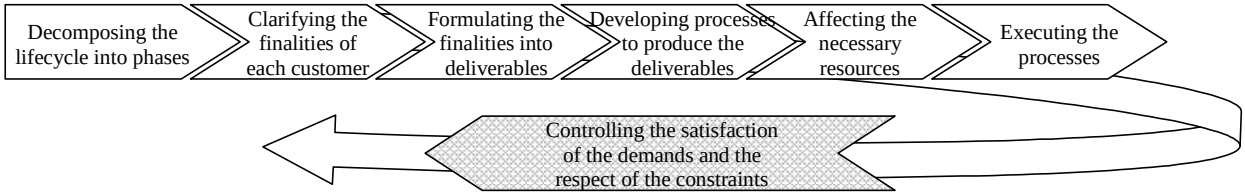


*Figure 4. Overview of the SCOS'D general method*

### 3.2 Presentation of the case of study

Our approach originates from the systemic approach presented previously. In this paper, it is applied to the design of the integrated research centre MIR*Cen*. The finality of the engineering and design office is here to work out a structure of research (an organisational structure of research and development) which is itself a system. Indeed the organisational system of research and development can be defined like the structure (the research centre) which, in the environment (that is competing, market of the drug, regional, national, international scientific policy), equipped with finalities (such as producing very high level scientific results and providing results of experiments supporting new drugs development), carries out an activity of production (scientific) and sees its internal structure (like human, financial, informational and technical resources) evolving through time (feasibility, definition, development, production, use, end of lifetime), without losing its structure identity (biological research centre). This research centre can be regarded as a system insofar as, it is a structure (a research centre), which, in its environment (CEA, public research, "pôle de compétitivité" Medicen Paris Region and other networks), provided with finalities (to develop new physiopathological models, to develop new tools of imagery and to test and validate new therapies), carries out activities (scientific research) and sees its internal structure evolving during its lifecycle, without losing its own identity (research centre in preclinical imaging). The systemic approach that is proposed is a method which makes it possible to integrate the various aspects of performance and creation of values (such as sustainable development, environmental protection, safety, hygiene, ethics or working conditions). The suggested method consists in simultaneously considering the system and its interfaces, which makes it possible to preserve a global vision of the system. The systemic approach thus makes it possible to cover the whole of the aspects of the research centre MIR*Cen* and to face its complexity. That is why we chose to use a systemic approach to get onto our study case, to face complexity, multiple aspects and interactions of MIR*Cen*, in order to take into account the various objectives of performance and the necessity to be flexible. To the source of our study is the CEA's wish to design this research centre in the objective to guarantee a global performance level, as well on the point of view of economical value

creation as on the one of the scientific, societal and environmental values. The general objective of this study is to design, to foresee and to optimise the functioning of such a pole of competence, in particular in terms of creation of values (like scientific, environmental, societal and ethical values).
MIR*Cen* (Molecular Imaging Research Centre) regroups and capitalises existing competencies and creates new competencies about medical imaging in particular. Its vocation is to become a European, even a world pole. This centre is a centre of preclinical imaging, i.e. the experiments are executed exclusively with animals. The results are afterwards transferred to the human being. Used techniques are Magnetic Resonance Imaging and Positron Emission Tomography. The project belongs to one of the four priority development axes of the CEA: "technologies for information and health" and results from an association of several actors. It functions in narrow collaboration with public institutions, hospital departments and other poles and networks (innovative context).
It is foreseen that MIR*Cen* represents about 6.000 m² and 80 permanent persons on the site and approximately 150 persons which are linked to the project, like physicians, mathematicians, chemists, neurobiologists, pharmacologists, clinicians or medical practitioners. The research topics are pharmacological tests, cardiovascular diseases, central nervous system diseases, hepatic diseases and AIDS. MIR*Cen* has three goals: to develop fundamental researches, to develop innovative therapeutics and to develop and validate new tools of imaging. But it is not only a pole of development. It is a technological valorisation pole too and it has different formation missions.
Performance, innovation and values creation are thus for this centre a priority. In order to better understand the different levels of analysis on which this study is located, this work lays on an arrow collaboration with different persons of the CEA: the leader of the industrial partnerships of the Fontenay-aux-Roses centre, the scientific project manager of the future research centre MIR*Cen*, the director of the Institut d'Imagerie BioMédicale, the director of the Fontenay-aux-Roses centre and the second-director of the Direction des Sciences du Vivant. This collaboration enables to regroup technical operational vision, organisational operational vision and strategic vision. The most significant characteristics of this study case are the multiplicity of the stakeholders, the multiplicity of the values, the type of the system (an organisational system) and the phases (feasibility, design and production) to consider. The design system and the designed system are presented in Table 1.

*Table 1. SCOS'D general method and application to the design system and the system to be designed*

| SCOS'D general method | Design system | System to be designed |
|---|---|---|
| Decomposing into phases of its life cycle | Feasibility study, preliminary study, study, launching… | Feasibility, definition, development, production, use, end of life… |
| For each phase, clarifying the finalities of each customer and the constraints of each environment | Working out a structure of research, an organisational structure to advance scientific research, to equip the country with means of research … | Producing high level scientific results, providing results of experiments, supporting new drugs development… |
| Formulating these finalities into deliverables | Argued report about the governance modes which have to be set up for the new R&D centre, a balanced scorecard of the creation of values… | A profit and loss account of the creation of values… |
| Developing the processes which are going to produce the deliverables | Design processes of the governance modes, of the balanced scorecard… | |
| Affecting the necessary resources to the activation of the processes | | |
| Executing the processes | | |
| Controlling the satisfaction of the demands and the respect of the constraints | | |

### 3.3 The systems and phases decomposition

The aim of this study is to design and install the specific and appropriated processes for this system and its strategic objectives. The systemic approach enables to cover all aspects of the centre and to face its complexity. From its principal issues and objectives, the necessary organisation can be structured. For instance, we can consider the first strategic driver of MIR*Cen*: scientific excellence. This issue can be stated as "generate and produce original and innovative scientific results". In order to answer this objective, we need processes and flows which generate, produce and create the values, human resources and means which the scientific results are resulting from, and a positioning strategy and measure tools so as to define and evaluate the original and innovative aspects. Considering now the two principal phases of the project (setting up and exploitation), each element (like processes, flows or human resources) can be associated to an action to set up. These actions can then be regrouped into systems and make the links between them appear. A first structural organisation of the research centre is thus obtained (cf. Figure 5).

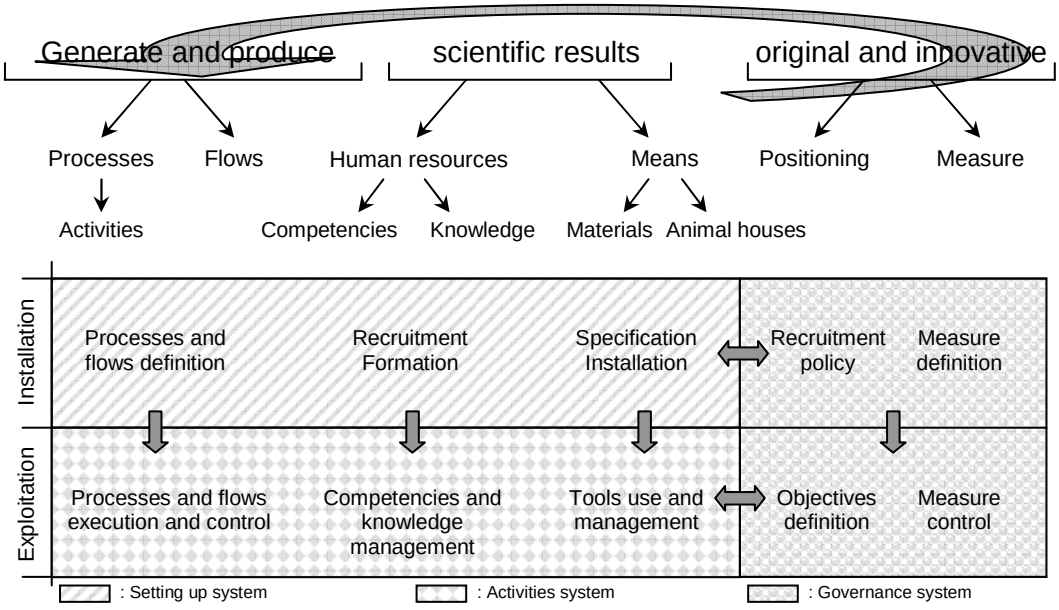


*Figure 5. System decomposition method*

This approach can be reiterated for each action. We consider then the action as an objective and we decompose it into needs (such as processes, flows, human resources or means), then into actions. By repeating and detailing this method, a fine decomposition in systems and sub-systems necessary to answer the issues is obtained.

By applying this approach to the integrated research centre MIR*Cen*, a first modelling of this organisation is obtained (cf. Figure 6). The activities system is the research system by itself: its role is the scientific production meeting the expectations and the needs of the customers (internal or external). It is composed of:

- a scientific activity system, core business of the research centre MIR*Cen*, which produces the scientific experiments;
- a provisioning activity system, which attends to supply the necessary raw material for these experiments;
- a valorisation system, which is responsible for the valorisation of the obtained scientific results under the form of patents or publications for example;
- a methodological activity system, which attends to all support activities, such as finances, human resources, maintenance and juridical activities.

The setting up system aims at designing and producing the activities system and the governance system from the established specifications. It is thus anterior to the activities system and continues until the launching of this system. The governance system aims at strategically positioning and repositioning the activities system from its design and during all duration of its use.

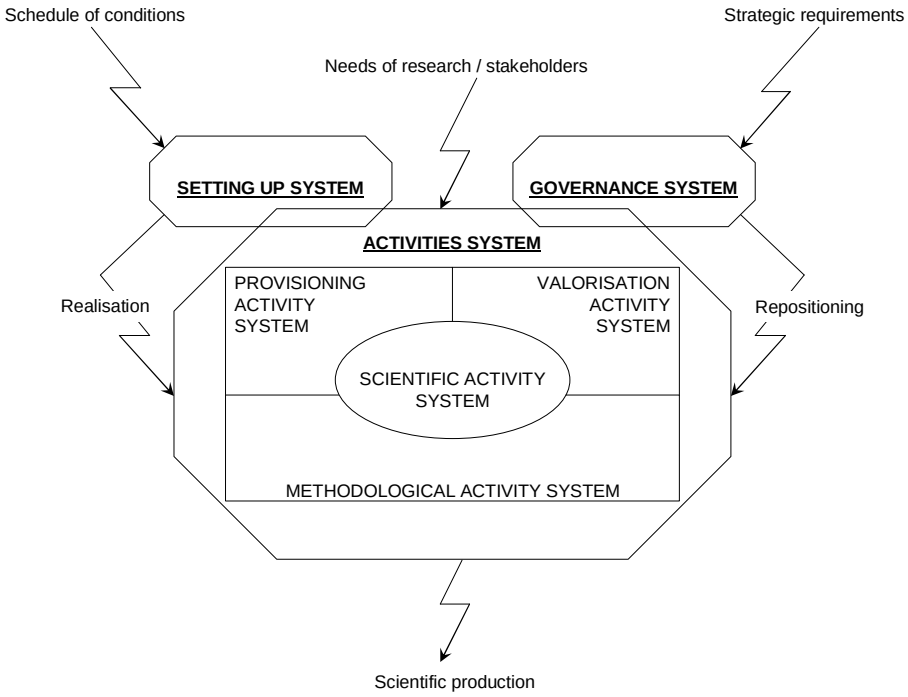


*Figure 6. Decomposition of the MIRCen system*[1]

For each of these systems, the different phases of the lifecycle are formulated (cf. Figure 7). For example, the governance system role is basically to fix the strategic objectives and establish the measure tools. Its three principal phases are the constitution of the governance structure, the execution of the governance and finally the dissolution of the governance structure. We will not detail in this article the object of each phase.

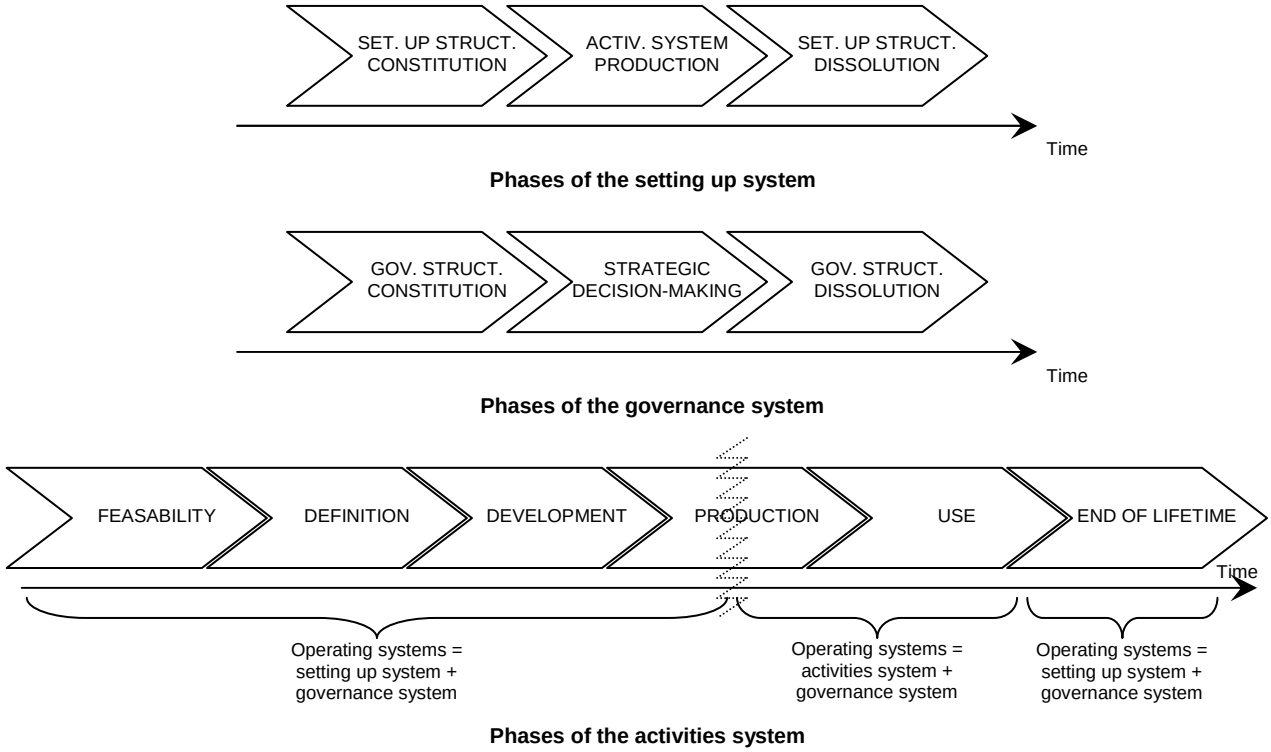


*Figure 7. Phases of the MIRCen systems*

[1] The different terms have been chosen to communicate with the members of the CEA, who are not familiar to the systemic language.

The core business phase of the MIR*Cen* system is the use phase of the activities system.

# 4 STEPS AND FOLLOWINGS OF THE SCOS'D METHOD

## 4.1 The different steps of the SCOS'D method detailed for MIR*Cen*

To design the activities system for example, we consider it in its principal phase, the core business phase, which is its use phase. Then the stakeholders, issues, deliverables, processes, and resources that are necessary to execute correctly this phase are listed. We can thus design the useful organisation and establish the essential means which enable to meet the demands of the stakeholders in the best possible way. Here these steps are presented in depth.

### *4.1.1. List of the stakeholders and of their issues and deliverables*

After this work of decomposition, for each phase of each system, the method consists in establishing the list of the stakeholders. We chose to present thereafter the activities system in its phase of use, core business phase of the integrated research centre MIR*Cen*. The different stakeholders of the use of the activities system are identified using the decomposition presented in Table 2:

*Table 2. Classical categorisation of the activities system use stakeholders*

| | | | | |
|---|---|---|---|---|
| 1. | Customers | | Who does the activities system use bring an added value to? | |
| | 1.1. | Final customers | | Who is this use intended to? |
| | 1.2. | Shareholders | | Who invests (time or money for example) in this use? |
| | 1.3. | Employees | | Who realises the activities system use? |
| | 1.4. | Mankind | | What is the contribution of this use to the society? |
| 2. | Environment | | In which environment is the activities system use located? | |
| | 2.1. | Competitors | | Who are the competitors of this use? |
| | 2.2. | Suppliers | | Who provides the necessary elements for this use? |
| | 2.3. | Market | | What is the market of the activities system use? |
| | 2.4. | Mankind | | Which society constraints does this use have to respect? |

This decomposition results from different analyses. It is inspired from "4C" of Bourrier et al. [19]: Customers, Capitalists, Collaborators, Citizens, associating other stakeholders appearing in the competitive forces of Michael Porter [20]. The idea is to not dissociate the customers (creation of values) and the environment (constraints and destruction of values). The objective is to create the maximum of values while avoiding destructing other ones. The customers are considered in terms of creation of values whereas the environment is considered in terms of constraints. In the Table 3 a sample of different selected stakeholders is presented. The list is not exhaustive.

*Table 3. Examples of stakeholders of the activities system use phase*

| Customers | | Environment | |
|---|---|---|---|
| Final customers | 1/ Internal<br>2/ Collaboration<br>3/ Providing<br>… | Competitors | 1/ Other imaging centres<br>2/ Other CEA's research centres<br>… |
| Shareholders | 1/ CEA<br>2/ Région Ile-de-France<br>… | Suppliers | 1/ Chemical products<br>2/ Animals<br>… |
| Employees | 1/ Technicians<br>2/ Researchers<br>… | Market | 1/ Scientific research<br>… |
| Mankind | 1/ Sick persons associations<br>2/ Scientific community<br>… | Mankind | 1/ Environmental associations<br>… |

Each stakeholder has to be taken into account and a specific weigh has to be assessed for each of them so that the list is usable. This first list is very important as it defines who the system has to satisfy. But

how can this satisfaction be ensured? What are the expectations of each stakeholder? How can their satisfaction be measured?
The list of the issues and deliverables aims at identifying the expectations of each stakeholder. The work has only been drafted for the moment and is still in progress. However, some examples of issues and deliverables can be presented in order to clarify the study and present its continuations.
It can be interesting to distinguish two kinds of issues for each stakeholder: the classical issues, which are common to most industrial systems, and the specific issues to research systems in general and to the activities system of MIR*Cen* in particular. We adopted this decomposition to present the following issues and we applied it to the use phase of the activities system (cf. Table 4).

*Table 4. Examples of issues for the different stakeholders of the activities system use*

| I. Examples of classical issues for the different stakeholders of an industrial system | | | |
|---|---|---|---|
| Final customers | 1/ Conformity product and/or service<br>2/ Continuous improvement<br>3/ Innovation<br>… | Employees | 1/ Interest of the work<br>2/ Remuneration<br>3/ Gratification<br>4/ Social climate<br>5/ Working conditions<br>… |
| Shareholders | 1/ Value<br>2/ Profitability<br>3/ Image<br>… | Mankind | 1/ Ethic<br>2/ Employment<br>3/ Environment care<br>… |
| II. Examples of specific issues for the different stakeholders of the activities system of MIR*Cen* | | | |
| CEA | 1/ Publications value<br>2/ Industrial contracts<br>… | Researchers | 1/ Available means<br>2/ Collaboration networks<br>… |
| Providing | 1/ To develop more quickly<br>2/ To develop less expensive<br>3/ To decrease attrition rate<br>… | | |

These issues have to be supported and specified for the activities system of MIR*Cen*.
For each of these issues, a list of interests, satisfactions, criteria of satisfaction, and then deliverables can be found. For example, for the issue “to develop more quickly”, the deadline respect is a very significant criterion for the providing. We thus obtain an ensemble of deliverables which may be redundant (two industrialists which would like a deadline inferior to 6 months), or contradictory (an industrialist which would like the total availability of the equipments for 1 month and the CEA which always wants to have the quarter of time to its disposal), or useless (most of the industrialists which would like a deadline inferior to 6 months; another one which would like a deadline inferior to 2 years)… They have to be aggregated to eliminate all these problems (for example by choosing the minimum of all wished deadlines). The weighing that can be set up enables to take into account the relative importance of the stakeholders. We thus obtain a restricted list of homogeneous deliverables on which we can rely on to build the necessary organisation to answer them.

#### *4.1.2 Necessary processes and resources*

The system can now be designed to meet the issues of each stakeholder in the best possible way. The necessary processes to produce each of these aggregated deliverables can be determined. Then the activities to be set up for each of these processes can be listed. Finally the resources used for each of these activities can be established.
Since we are in a design phase, some uncertainties naturally remain. That is why we chose the most global possible analysis even if it requires removing aspects of this analysis thereafter if necessary.
To define precisely the activities system, it is necessary to establish well its structure (what the system is: who is implied and to what level in its use?), its activity (what the system does: what is the role of the activities system?), its evolution (what the system becomes: what is the envisaged future of the activities system?) and its finality (what the system brings: who and what is this system meant to be

good for?). Then with some sensitivity analyses, we can find the most significant points and thus detail them. This method has to be applied to all phases of all systems of MIR*Cen*.

### 4.2 Perspectives of the SCOS'D method

This systematic approach can be used on all sorts of organisational systems to design them and set up performance measurement, quality management, costs / values command and control, or to study the various methods of research valorisation for instance. It enables to create adaptive structures: if the environment of an organisation changes, the implications of this change for the issues and then for the necessary structure and resources can be seen rapidly.

It is not so easy to control the R&D processes performance [21]. But if we consider the different customers' demands and environments' constraints with the three efficiency types of Michel Kalika [22] (economic, organisational, and social, we can add environmental too), we have a robust indicators database to measure this efficiency. We have developed some indicators roadmaps, but we have not developed piloting processing to change the dysfunctioning processes.

This study has conducted us to develop a tool of management called SCOS'C² (Systemics for Complex Organisational Systems' Command and Control). It deals with a database which gathers the whole data of MIR*Cen*. This tool enables to process simultaneously all objects of the research centre, such as resources, values, costs, systems, processes and phases, and so to manage this research centre. The SCOS'D method and the SCOS'C² tool are at this time validated by the CEA which uses them to design MIR*Cen*.

## 5 CONCLUSION AND PERSPECTIVES

In this paper we present an exploratory research on a multi-criteria design method for organisational structures, called SCOS'D. Based on a systemic approach inspired from the works of Jean-Louis Le Moigne, this method enables to integrate all company's stakeholders' points of view and expectations in order to design an organisational structure. Furthermore, this method could also be used to manage the evolution of the organisational structure and to follow its performance. Thanks to our systemic design approach, we suggest that companies could adapt their organisation to the economic changing environment and set up changing performance indicators. We have developed this theoretical proposition thanks to the beginning of the MIR*Cen*'s design. The development of this study case is one of the perspectives of our research. A first model has been produced for the integrated research centre MIR*Cen* and leads to promising results to support. Our perspective is to improve this model and to validate it with other study cases; two of them are on study: the NeuroSpin centre of the CEA of Saclay and the Service Hospitalier Frédéric Joliot in Orsay. The multi-criteria point of view on performance should enable to represent the global creation of values of a company, through the SCOS'C² tool. These values are often very subjective and not directly countable; it is appropriate to set up values indicators that are comparable between themselves and representative of the reality, which is one of our work perspectives. We will have to value more specifically whether managers could use easily such methods to design, manage and adapt organisational structures. Furthermore, in our future researches, we also aim at characterising the impact of such designed organisations on global value creation for a company.

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