A Strategy Absence or a Tacit Strategy?
Case ATLAS Experiment at CERN

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Abstract

This case study focuses on the ATLAS Collaboration at CERN. ATLAS is one of the six LHC (the Large Hadron Collider) experiments. It is a scientific collaboration consisting of over 2,100 researchers and almost 170 research institutes from all over the world. The Collaboration has designed and built a new particle detector which is one of the biggest devices ever built and is now ready to discover the secrets of the Universe and matter. The organization has a scientific mission to find a sub-atom particle named the Higgs Boson. Finding the Higgs boson would complete the Standard Model and would probably be awarded with the Nobel Prize in Physics.

ATLAS is defined for this study as an international scientific nonprofit organization in between private and public sectors. An organization of this size and complexity could be assumed to have a detailed strategy according to which the building project has proceeded. However, there is no outspoken strategy or codified strategy document in ATLAS. The management of the experiment has attempted to improve by using theories originating from the business world but these attempts have had little benefit to the management.

The aim of this study is to find out why the ATLAS organization does not need a codified strategy. The question is discussed by studying the characteristics of the ATLAS organization and the people working for it. For the study, seven semi-structured theme interviews were conducted with the ATLAS management.

According to strategy theories, the organization strategy defines the organization structure. This study claims that in ATLAS there is a tacit strategy that is not outspoken but implicitly executed by everybody. This is due to the types of people working for ATLAS. They are highly motivated by scientific curiosity, capable to work on their own initiative and willing to do even more than is expected. This makes a flexible and nonhierarchical organization structure possible, which for its part is essential for effective problem-solving and thus, for the progress of the project.

**Keywords:** Strategy, strategy absence, tacit strategy, organization, scientific collaboration, ATLAS, CERN
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Best things in life often happen by hazard and with a little luck. I never dreamt about working at CERN which I recognized by name being the most remarkable center for nuclear physics. Little knew I then.

While working on my Master’s thesis at CERN my knowledge has evolved. I know now that CERN offers great research challenges not only for particle physicists and engineers but also for social scientists. I have been privileged to enjoy the enthusiasm of highly talented people around me. In this occasion, I want to thank some of them by name.

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Appendix 1. An example of interview outline with ATLAS management
1 Introduction

There are some similarities between particle physics and organization studies. Both are searching for something that can not be directly seen or touched but can be modeled and predicted by theories. Many people are convinced that leadership and organization culture, as well as particles smaller than atoms – such as quarks and bosons – do exist even though one may see traces of them but never the actual phenomenon itself. Common is also the aim in all sciences, namely to create new knowledge.

Both particle physicists and organization researchers face thus the problem of unobservability (Godfrey & Hill Jr. 2000). However, that is basically where the similarities end. To test theories of particle physics, one needs gigantic apparatus and contribution of thousands of people for many years if not decades. Still, the best one might obtain is traces of the long-hunted particle, a track that appears on one’s screen after weeding out tremendous amount of useless data. Organizational research for its part is done mainly by reading previous writings of other researchers and observing organizations and their members. This may naturally take time and involve several researchers and assistants, but compared to science projects, demands are however moderate and results will be gained within a reasonable time.

But the fundamental difference between particle physics and organizational research – and that confuses us a lot – is that like all natural sciences, particle physics is based on scientific principles and natural laws that are universal and measurable. The social sciences fall instead into the category of non-exact sciences that are not based on widely known and accepted axioms. Knowledge in social sciences is not unvaried and universal, but relative to place and time. Therefore it would be more accurate to talk about constructions or interpretations rather than knowledge (Palonen 1988).

In order to enhance our knowledge about nature and the universe, scientists form scientific organizations: research teams, institutions and collaborations just to name few. These social and organizational constructions are of interest to social and organizational researchers. But not only for them as there still is another aspect, like in every human activity nowadays: the
economic dimension. A fundamental question is how scarce resources can be allocated and used in the best way. Efficacy, effectiveness and productivity are key terms by which organizations are evaluated by economic scientists. Their theories have been widely used with success in business and for-profit organizations, in which also new theories, doctrines and tenets emerge by practical experience.

Organizations try to optimize their actions and operations. There exists dozens of theories, how an organization should be structured and managed in order to get the best possible results (e.g. Chandler 1962, Fayol 1949, Lynch 1983, Mintzberg 1979; 1983, 2007, Weber 1968). Strategy has become one of the key concepts in managing organizations. There are strategies of every kind: for example a marketing strategy, a human resources strategy, an outsourcing strategy, an innovation strategy and so on (e.g. Ansoff 1965, 103). Strategy is often seen as key to success, even though it is less clear what is meant by it.

Theories of strategy and strategic management originating from business life have tried adapt to public sector organizations (e.g. Ring & Perry 1985). It is less studied, whether these concepts are applicable to other than for-profit organizations. In fact, these may have some assets and models that could be applied even in business life (Santalainen & al. 2007).

Scientific organizations are usually nonprofit oriented, funded by public resources. Their aim is not to produce goods or services but instead, to generate or enhance knowledge. CERN, the European Organization for Nuclear Research (also known as the European laboratory for particle physics)\(^1\) is situated in the Swiss-French border near Geneva. It is one of the Big Science centers and among the most remarkable research institutes in the world, hosting several more or less autonomous research collaborations. ATLAS is one of the two biggest experiments and collaborations at CERN, involving 167 universities and over 2100 persons.

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\(^1\) The original name for CERN was Conseil Européen pour la Recherche Nucléaire from which the acronym was derived. See more: [http://public.web.cern.ch/public/en/About/Name-en.html](http://public.web.cern.ch/public/en/About/Name-en.html). Data accessed July 10th 2008.
The management and strategy formation of ATLAS were tried to be perfected by theories originating from business life, detailed later in this study. This approach had, however, limited help for the ATLAS management. This raises the question whether strategy theories used successfully in business organizations are applicable in public and nonprofit organizations. This study is a case study about ATLAS and it calls into question whether the strategy concept is meaningful in the context of a scientific, nonprofit international expertise organization. The study will combine the points of views of sociology, philosophy of science, economics and organizational studies. This is perhaps not the most straightforward approach, but we believe that by examining organization and its features little deeper we discover interesting interdependencies.

The study proceeds as follows: First, we will define the research question, review the material and research available. Second, in order to understand better the operational environment of ATLAS, a short introduction to particle physics is presented. Third, the methods and methodology used for this study are discussed. Fourth the ATLAS organization is presented in relation to strategy literature introduced earlier. Then, the research questions are discussed. The study is concluded by presenting the conclusions of the study and some suggestions for further studies are presented, too.
2 Research Question and the Research Strategy

The scope of this study is the organization and management of the ATLAS experiment. In short, ATLAS is a scientific collaboration at CERN consisting of 167 institutes from 37 countries on five continents, involving 2100 scientists, engineers and PhD students. The main purpose of the collaboration is to enhance our understanding about the Universe and structure of matter. One of its primary goals is to find an elementary particle, the Higgs Boson. Finding it would complete the Standard Model, which is a theory unifying three of the four known basic forces in the Universe. In order to fulfill its mission, the Collaboration has built a gigantic particle detector to study elementary particles. The ATLAS detector is one of the biggest and most complex machines ever built.

An organization of this size could be assumed to have a detailed strategy implemented through a clear organizational hierarchy. Instead, ATLAS appears to be more like an anthill: it is highly self-organized; decisions are taken collectively and the whole organization functions in a bottom-up fashion.

The aim of this study is to find out what makes ATLAS fly in the face of some recognized premises and theories of organizational and managerial science. The study is based on previous research literature, complemented by interviews with several key actors in the ATLAS organization. It combines organizational, sociological and managerial points of view. This is neither the most common nor an easy approach. However, it is believed that it will capture the organizational features related to ATLAS and reveal aspects which would otherwise remain undisclosed.

It should also be noted that scientific interorganizational collaborations have not been widely researched by organization science studies (Chompalov & al. 2002, 750). The research question is examined through the organizational characteristics of ATLAS. The organization will be viewed as an international, scientific, nonprofit, parastatal2 expert organization.

2 “Parastatal” is a term used by Santalainen (2006, 56) to describe an organization which is neither public nor private.
In literature review it is questioned whether the strategy and strategic management can be applied into public and nonprofit organizations. However, we assume that they can benefit from strategy and strategic management as well as profit-seeking organizations. It is all about how these concepts are defined in each context.

The success and failure of the ATLAS experiment and the organization are unambiguous: either the detector as a whole works or does not work as designed. It is not enough if most of the detector subsystems work nor is it sufficient if the components almost work as they are supposed to. In the utilization phase one of the main goals, is to discover the Higgs boson. However, even if the boson is not found, it would not necessarily imply a failure at the project. It is always possible that the boson will be discovered later on or by someone else. However, the experiment will provide new information since the LHC enables the highest energy level ever obtained.

It is challenging to find a suitable framework for this study, as the research and literature concerning strategy and management in general handle usually more conventional organizations, whose aims are different and the measurement of success is not the same. The results can often be better or worse than the set objectives and usually it is not that critical. In business organizations, it usually is not that serious if some departments are not meeting all their goals in a given time; the other departments and the organization as a whole can still (out) perform their functions. In case of ATLAS the question is often either all or nothing, but not something in between.

In this study we will examine the ATLAS organization from four aspects, namely as a scientific, international nonprofit expert organization. As ATLAS is also funded mostly by public funding agencies, the dilemma of public/private organization is shortly treated in the study. All these aspects will be treated in detail later.

The strategy and management theories used in profit-seeking organizations have had a limited use for the ATLAS management. This study tries to find out whether similar experiences have been noticed in other organizations like ATLAS. Furthermore, a concern
is why the suggested business models did not work in ATLAS and whether these experiences could be useful in other similar organizations and in management and organization research in general.

We assume that as ATLAS has functioned well over 15 years and has been able to build a huge particle detector without an outspoken strategy, there has not been a need for such a document. Instead, we are interested in reasons for that.

The main research question is: Why does ATLAS not need a clearly identifiable collaboration strategy? The supporting questions are: How can the ATLAS organization be characterized? How can it explain the apparent absence of a codified strategy and its apparent efficacy as this highly complex gigantic detector is now completed?

Hypothesis:

1. ATLAS is a quite unique and original organization. However, it can be classified as an organization; in many ways its most dominant character is that of the research organization. The organization culture of ATLAS can thus be characterized by attributes typically related to a research organization.
2. There is no specific need to codify or spell out a strategy for ATLAS as the people involved are self-motivated and their activities are conducted by a shared common goal – the accomplishment of the ATLAS experiment and to find new elementary particles.
3 Literature Review

Science and research are always based on previous studies and existing knowledge that appear in the form of theories. In everyday parlance theory is abstract and used for something that has little to do with real world (Alvesson & Deez 2000, 37). In positivist research tradition, theory represents experience, as for Alvesson & Deez a theory is not an abstract representation but rather a “way of seeing and thinking the world” (ibid.). Using a theory is thus comparable to wear glasses through which the world is seen in a certain way.

This study belongs to the field of social sciences, having as the subject a scientific organization, in which scientists and researchers are doing science. Niiniluoto (1984, 2) notes that the word science has four-fold meaning: it may refer to the scientific 1) institution, 2) process, 3) method or 4) knowledge and these four aspects often also define each other. Hereinafter, the terms science or scientific refer first and foremost to natural sciences, or rather, the basic research conducted to enhance the knowledge, without aiming at practical applications or commercial purposes (Niiniluoto 1996, 13).

Both CERN and ATLAS have been studied from several points of view, by researchers of different fields. We will here present shortly the most relevant ones with regards to the present study, as well as the theories in which we base this study.

Scientific communities formed by high energy physicists have been researched in sociology of science and in social anthropology. Sharon Traweek (1988) conducted a years study comparing particle physicists at KEK research institute in Japan and in Stanford Linear Accelerator Centre (SLAC institute) in the United States. The community of high energy physicists in ATLAS is one example of cultures researchers create in Knorr–Cetina’s (1999) study of epistemic cultures and knowledge creating.

The administration of ATLAS has been studied by means of strategic business management (Santalainen & al. 2007). A series of three workshops was organized by a consult to the top management of the experiment in 2003–2005, in order to fortify the strategic management and to give the management tools for it. The models to be used were Hamel’s Business
Model (Hamel, 2000) and the Strategy Diamond developed by Hambrick and Fredrickson (2001). At the time, the ATLAS Business Model (ABM) was created. Nevertheless, the ATLAS managers did not find them to be applicable in their daily activities since the developments in ATLAS are often unpredictable and in some cases, reversible. (Santalainen & al. 2007).

Between the viewpoints of Knorr–Cetina and Santalainen & al. is research conducted by Lyanage & al. (2007) “Managing Path-Breaking Innovations. CERN-ATLAS, Airbus and Stem Cell Research” which compares emerging innovations and their management at the ATLAS organization, in the design process of the new Airbus A380 jumbo jet and in stem cell research. Whereas Knorr–Cetina studies ATLAS and the molecular biology research as communities of researchers creating knowledge, Liyanage & al. combine technological, economic and managerial factors which contribute to innovations and breakthroughs in the three different fields.

Besides the authors and studies presented above there are several other studies concerning ATLAS, for example Master’s and doctoral theses. This study continues for its part the work of Santalainen & al. and the other studies made on ATLAS.

3.1 Organizations

Etzioni (1961, xi) defines an organization as “a social unit devoted primarily to attainment of specific goals” (see also Parsons 1960, 17). There are several ways to classify organizations: for example by their purpose or function, scope of activities, geographic position or the type of their organizational structure.

An organization is fundamentally characterized by its ideological orientation which affects on the behavior of its people, its ability to meet their needs and demands and the way it copes with the external environment (Harrison 2000). It determines how decisions are made, human resources are used and the external environment is approached (ibid.).
Structure is the administrative design of an organization, presented as either formally or informally defined lines of authority and communication, through which the information and data flow (Chandler 1962, 14). The lines go throughout the organization; they define the hierarchy and the power relations between employees, middle managers on the different levels and the top management (Fayol 1949). It was also stated that an employee should have only one direct supervisor (“unity of command”), and the number of employees one managers can handle (“the span of control”) is limited (Gulick 1937, 6–9).

A more recent approach to the organization structure includes job specialization, behavior formalization, design of positions, unit grouping and sizing and design of lateral linkages in the form of planning and control systems (Mintzberg 1979).

The structure is based on the strategy or, for the most complex structures, on several basic strategies; thus, the strategy defines the organizational structure (Chandler 1962). The internal structure affects also on organizational efficiency, effectiveness and communication (Sveiby 1997). There have been a counterarguments claiming that strategy follows structure (e.g. Bower, 1970).

### 3.1.1 Vision, Mission and Mandate

Mission and vision are central concepts in management and strategy literature (see for example Hamel & Prahalad, 1994). Mandate is more accurate when talking about public sector organizations which provide public services that set the limits to their activities (Bryson 1995, Jensen 1998). Vision and mission shape the organization aims and activities and are used as tools to motivate people working for the organization.

The concept of a vision can be explained by a desirable state in the future which motivates people, such as a common dream, the wanted state of affairs in the future (Huuhka 2005, 77). By some definitions, the vision can also describe how an organization would like to behave and what should it look like (Bryson 1995, 67). The management and the leaders have an essential role in forming the vision and communicating it to the whole organization.
The goal of an organization, often called as mission, is the purpose for which the organization stands for. It provides the psychological and emotional logic for the organization and in tandem with its mandates, the raison d’être and the social justification for its existence, an answer to the question why it really exists (Bryson 1995, 26; Phillis 2005, 15–16; Huuhka 2005, 76). Organizational goals are a state of affairs to which the organization heads to and which it tries to realize (Etzioni 1961, 70). There is often more than one goal and the goals can be of different types, such as economic and cultural (ibid. 72–75). If a vision provides the aim where one is heading, the mission is the reason why to aspire there. Organizations may have other aims that their principal goal or mission. (Bryson 1995, 66–67).

It should be noted that mandate and mission are not the same thing. For a public organization, mandates are given by outside stakeholders, whereas mission is developed inside the organization. Often organizations are allowed to do more than they actually are doing and what they are expected to do. (Bryson 1995, 66; 81). The mandate is closely linked to the funding: the donators demand their donations are used properly and for the purpose they were given (Jensen 1998, 170).

3.1.2 Classifying Organizations

An organization may be classified into several groups so the classifications are not exclusionary. We will here present some classifications and characteristics of different types of organizations relevant for this study.

**Scientific Organizations**

Scientific organizations are unlike many others. People are immersed into their work, they are goal orientated and not motivated by profit-seeking, nor even academic merits but by scientific progress and the excitement to discover something unknown. Their motivation is due to the science and pure knowledge. (E.g. Wolpert & Richards 1988). Scientists are
seldom keen in organizational promotions as such managerial tasks that divert them from research activities.

Science and basic research is one sector heavily funded by public resources. The role of science in the society is remarkable. Basic research not only produces knowledge but also leads to direct and indirect economic benefits (Salter & Martin 2001). Public financing of science is thus justifiable from an economic point of view as well.

According to Harrison (1972), organizations having the ultimate aim as the highest organizational value can be described as task-oriented organizations. Typical characteristics for these organizations are a high regard of expertise and disregard of rules, regulations and authority as such. The task-oriented organizations are also capable of dealing with complex and changing environments (ibid, 124). Scientific organizations are thus often task-oriented organizations, having scientific success as their aim.

Tenets of the scientific organization have slightly adapted to the research and development (R&D) organizations. Elkins and Keller (2003) have noted that R&D activities vary from the other functions of the company: they require time, they are sporadic and they are of nonmarket nature. Likewise, pharmaceutical companies may share these characteristics (Katen 2004, see also Santalainen & al. 2007 and Sveiby 1990, 264–269).

**International and Multinational Organizations**

Classifying international organizations is complicated. The term “international” refers usually to the public or nonprofit sector (Archer 2001, Geri 2001). Instead, when referring to business organizations the term multinational or transnational is used. Depending on the definition they may refer to a company having a certain percentage of their activities aboard, or to a company with completely international management and having its activities and shareholders spread all over the world. (e.g. Kono 1984, 143; Stopford & Wells 1972).

It should thus be noted that the terms “international” or “multinational” may refer to very different characteristics. In public organizations “international” is usually linked to
cooperation between states or national organizations, whereas “multinational” in the private sector is one entity of inherently international nature. The latter may well consist of several national affiliates, but the activities are dispersed in several countries.

In the public sector, there are inherent definitional problems in terms of international organization, such as forms of their membership, accountability structures and missions (Geri 2001, 450). One way to categorize them is grouping according to their membership: interstate or intergovernmental, non-governmental and mixed membership (Archer 2001, 35–36). Distinction can also be made by the mission or the function of the organization. For example the European Union states their function as enhancing and strengthening the economic and social well-being without internal frontiers in (somehow) geographically restricted area (Treaty on European Union). The role of the International Olympic Committee for its part is to promote top-level sport and ensure the celebration of the Olympic Games on regular basis.

In companies, there are universal principles that shape the organizational activities all over the world but also factors that are related to national cultures (Kono 1984). According to Hofstede (1994) national cultures have four dimensions: 1) social inequality, including the relationship with authority, 2) the relationship between individual and collective, 3) concepts of masculinity and femininity and 4) tolerance of uncertainty and ambiguity. This results in cultural relativism also in international or multinational organizations, which means that cultural differences must be taken into account in order to avoid mistaken cultural perceptions (ibid.).

Cultural differences can be seen for example when comparing organizations in the East with those in the western countries (e.g. Hofstede 1994, Rehder 1979, Hall & Leidecker 1981). Japanese organization system can be characterized as a democratic bureaucracy, in which a loose organization structure, employee involvement in decision-making and achievement as well as academic excellence are emphasized (Rehder 1979, 22–23; Hall &
Leidecker 1981, 15–16). The management is bottom-up\(^3\) process, group decisions are made at every level, and managers are facilitators, managing by “walking around”; however, the top management is highly respected above the others (ibids, Kono 1984). On the other hand, the participatory decision-making is also time consuming and it can be questioned whether the time could be used more effectively (Kono 1984, 44).

Due to differences of cultures but also of environments between countries, the best practices of companies are not always easily transferable from one country to another (Kono 1984). The same applies to any organization and also in science (Sonnenwald 2007). Traweek (1988) describes how the cultural values and practices troubled Japanese-American HEP collaboration despite the common field and the membership of the collaboration. By acknowledging that such cultural differences and national effect exist it is easier to cooperate in international or multinational organizations.

**Knowledge and Expert Organizations**

The character of work and the role of people in it are in current change (Hammer & Champy 1997). The bureaucratic organization hierarchy and decision-making model by Weber (1978) with its detailed processes, structures and responsibilities apply only weakly to modern expert organizations. The nature of work has at many working places turned to be knowledge intensive. This kind of organizations is called knowledge, expert or professional organizations (Etzioni 1961, Sveiby 1997, Temmes 1992).

Knowledge and information are often mixed but although closely linked, they are not the same thing (see for example Nonaka & Teece 2001). The concept of knowledge is discussed since the Antiquity (e.g. Aristotle and Plato). In this occasion, it is enough to note that knowledge is converting and exploiting the information and capacity to act in a way that information is used in the best possible way (Sveiby 1997). Information as such is thus

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\(^3\) Bottom-up is the counterpart of top-down management, which is basically the classical hierarchic pyramid model, visualizing the dyadic relations between top and middle managers, as well as between middle and front-line employees. The bottom-up model can thus be demonstrated by a pyramid standing on an angle. (Nonaka & Takeuchi 1995, 125).
quite valueless, if it is not exploited. On the other hand, knowledge is transferred via information and traditions (ibid).

Specific and general knowledge can be distinguished by the transfer cost: the more the knowledge is specialized and attached to a certain person, the greater are the costs required to transfer it (Jensen 1998, 347–348). Knowledge is also an important part of personal competence, together with one’s skills, experience, social network and values. Sharing existing knowledge within an organization is essential in terms of creating new knowledge. (Sveiby 1997, 23; 28; 35).

Modern expert organizations have their roots in the development of information technology since computers were historically not used everywhere and there were only few people who knew about them (Temmes 1992). Universities and other research institutes, consulting or advertising companies, law firms, some administrative offices, hospital’s surgical unit or large artistic institutions are only examples of expert organizations, the number of which is constantly growing (Etzioni 1961, 52; Huuhka 2005, 194; Jensen 1998, Temmes 1992, Sveiby 1990).

Knowledge workers that are also called experts or professionals are highly educated and immersed in their complex problem-solving work. They require freedom, continuous learning, innovation and sharing of knowledge with others. They despise rules, limitations and formal control, but respect persons with higher professional competence than themselves. (Etzioni 1961, 52; Drucker 1999, 86; Temmes 1992, Sveiby 1997; 19, 57). The employees are capable of working on their own and organize their work and tasks by themselves. However, this requires a strong sense of responsibility. The role of the organization is to support this self-orientation, not to patronize. (Koskinen (1997, 210), Temmes 1992, 42; 126).

Knowledge and organizational structure seem thus be interdependent. This question has arisen when studying Japanese organizations as they often surpass their Western counterparts in terms of adaptability and knowledge creating (Ackoff, 1994; Nonaka &
Teece 2001; Nonaka & Takeuchi 1995, 3). This is due mainly to their organization structures and employee empowerment and involvement, which differ from traditional Western organizational hierarchy and bureaucracy (ibids.). The ideas of empowering employees; involving the whole organization into the decision-making and questions related to effectiveness instead of efficiency are suggested to be used more also in the Western organizations (Ackoff, 1994).

According to Koivunen (2005), collective expertise is an ongoing process and an ability to function together with other experts. Two aspects can be distinguished: professional know-how and capability to interact with others. One must know not only what to do, but also how (in which way) and when certain tasks are to be accomplished. (Hansson 1998, 39; 320).

The characteristics of knowledge intensive expertise differ from those of manual work. Therefore, the productivity of knowledge-worker can not be measured by the old indicators (Drucker 1999, 83). Experts must have a will to work for the organization and they must be given freedom and responsibility (ibid.). It is not about quantity but quality: the question is what to do and not how to do it as was the question in the scientific management (ibid, Taylor 1911).

Therefore, managing and motivating people in expert organizations can be challenging. The structure of an expert organization is flexible, flat (i.e. no high pyramidal hierarchies) and their management is decentralized. (Alvesson 1989, Temmes 1992, Sveiby 1990). Ideally, the expert organizations are creative and effective; functioning without control; this is not the case in reality. Also, as the organization grows so does the bureaucracy. (Temmes 1992, 127; 146).

Authority in expert organizations must be based on professional competence or charisma and the managers or leaders must be capable not only to motivate but also set limits (Temmes 1992, 137). Terms like “coach” and “orchestral conductor” are used to describe managers and leaders of an expert organization (Huuhka 2005, 250; Sveiby 1990, 88–89).
Charisma is what especially the political and religious leaders often have: a strong personal influence on others, over the normative orientations of the other actors (Etzioni 1961, 203). Charisma and competence are not always combined, a person may possess none, either, or both, and charisma may also appear in a bureaucratic organization (ibid. 207; 250).

In an expert organization, two kind of management or two roles of the manager are needed: administrative and expertise-related. These might be divided to two persons, which is the case for example in some hospitals (for assuring the medical expertise) or in theatres, ballets and such (to guarantee the artistic view). This model is justifiable to ascertain that both administrative and professional-related issues will be taken into account, but it may also result on conflicts between interests or points of view. (Jensen 1998, 193; Temmes 1992, 138–139; Sveiby 1990).

**Adhocracy**
Project organizations in which the decisions are taken little by little are called adhocracies. The idea of adhocracy as adequate organizational model for expert organizations was presented by Mintzberg (1979, 1983). The environment that adhocracies face is dynamic and complicated, the organization is self-conducting, the power is dispersed and the management structures are only semiformal (Mintzberg & McHugh 1985, 161; 191). The position and power of a person in an adhocracy are based on expertise and information one possesses (ibids). Adhocracy is based on projects or problems that are solved by teams that can be composed of experts coming from different specialties (Mintzberg & al. 1998, 308) or from different organizations.

The positive aspect of adhocracy is that it leaves the options open and gives the organization freedom to react rapidly or even change the course if needed. On the other hand, there is a risk that the organization loses its capability to concentrate on the essential. (Mintzberg & Mc Hugh, 1985). People must be given enough time and in order to be innovative and creative they must communicate a lot with each other which is time consuming and expensive (Sveiby & Risling 1987, 165). Adhocracy is thus not suitable for routine tasks but for solving unusual, knowledge-intensive problems in an innovative and
creative way (ibid; Huuhka 2005, 66–67). Extreme examples of adhocracy are situations in which the circumstances can change rapidly; such as military operations or dealing with hijackers. In such cases everything can not be planned beforehand in detail but one must be ready to improvise if needed. (Sveiby & Risling 1987, 159–161).

Leading an adhocracy differs from the traditional patriarchal management due to the few formalities and structures (Bearisto 1997, 101–107). Mintzberg (1979, 447) emphasizes flexibility in the organization and expertise; they must be considered more important factors than the formal authority.

**Public and Nonprofit Organizations**

Some time ago public organizations were thought to be equal to governmental activities and private organization covered the rest but the concepts are no more that unambiguous (Perry & Rainey 1988, 183). Nonprofit organizations neither have access to equity capital nor do they distribute dividends to owners. Their existence often suggests market failure in specific area or services. (Helmig & al. 2004, 104). In the following, public and nonprofit organizations will be treated synonymously since they share a lot of same characteristics. In most cases public organizations can be classified as nonprofit organizations.

The research of public and nonprofit organizations has been mainly carried out on organizations providing or supporting public services. As commercial values are mostly rejected, accounting and auditing have neither been widely executed nor researched in nonprofit sector. (Helmig & al. 2004). In addition, little study has been carried out about public expert organizations, which are characterized by their function to produce and process information for the benefit of the society (Temmes 1992, 22–23).

In some research literature, especially in the U.S. tradition, the focus is set on charitable organizations including many educational, social, cultural and religious services (Stone & Bryson 2000, 750; Bryson 1995, 4–5; Jensen 1998, 167). It is noted that there is a risk of overgeneralization in organization theory and therefore it is crucial to keep in mind the differences between the public and private sectors (Meyer 1979; 1982).
The debate about differences and similarities between private and public sectors has been going on at least a half of a century (e.g Hatten 1982, Pollitt 2003). However, it remains unclear where these similarities and differences lay. Pollitt (2003, 1–4; 8–25) summarizes the arguments and opinions of several authors for and against the similarity and the difference and some common claims or assumptions, where the differences, if any, lie. Pollitt starts from the Taylorian scientific management theory which doesn’t separate public and private management. He ends up concluding that there are contextual differences. A public sector manager has often (but not always) a different set of values and expectations to take into account than his counterpart in commerce. This is the case when “public sector” is understood in its traditional form, being close to government or other authorities and therefore under political control. (Ibid).

Activities of organizations of both types share some features but due to contextual differences, a different perspective is needed and the tenets originating from business life must be adapted (Stone & Bryson 2000, 750–751; Temmes 1992, 156). A significant difference is that for-profit organizations, especially private companies, seek for maximum profits whereas the public sector organizations are usually to fulfill their function (Hatten 1982, 89). There are often many stakeholders with contradictory expectations and management may be scattered between the actors and managers, no to mention being politically charged and having dispersed interests (ibid.; Bryson 1995, 28; Pollitt 2003, 83–85; 98–99). Public sector organizations usually also have more aims than the “number under the line” (Bryson 1995).

Public and private organizations have also a lot in common and they co-operate more and more (Linder 1999). Motivations for the partnership formation between private and public organizations include: 1) reforming and modernizing management, 2) attracting private finance, 3) strengthening public legitimacy, 4) shifting risk, 5) downsizing the public sector and 6) sharing the power (Pollitt 2003, 59; Linder 1999).

There hardly is a solution or best practice that could be applicable in all nonprofit organizations. But as business organizations vary in their size, niche or focus, so do
nonprofits. The environment and context matter: for example, cultural differences can be distinguished and the differences are not only across the sectors, but also within them (Pollitt 2003, 161–167).

The same applies also to similarities: some public and private organizations may have more things in common with organizations outside, rather than inside their own sectors. As an example, large universities resemble any complex business organization more than a small nonprofit organization, and competition and egoism usually attached to for-profit activities can be also found in universities (Jensen 1998, 195; Temmes 1992, 128). It is thus more meaningful to concentrate on the very characteristics of one given organization rather than to treat it as a representative of an entire sector or compare different sectors.

The discussion about differences and similarities between private and public is nevertheless interesting. For the purpose of this study it is however adequate to note that such a discussion does exist and acknowledge that it could have had an impact on the studies and ideas presented by different authors.

**Network Organizations**

The coalitions are a requisite nowadays. The companies seek for coalitions to better exploit their own and joint resources but also gain advantage from each other’s image. A partner with a good reputation is a valuable reference and the positive image of one partner will also be associated to the other. (Hamel & Prahalad 1994, 205–214). Collaborating with other organizations is profitable if synergies can be found and exploited, although finding a balance between too tight and too loose a cooperation is not always easy (Brown & Eisenhardt 1998). By synergy we mean the combined effect when the resources produce together more than the sum of their individual parts (Ansoff 1965, 79).

**3.1.3 Motivation, Commitment and Competition**

There are over 30 theories about motivation trying to explain why people act as they do and what is the force that drives them (Liukkonen & al. 2006, 10–12). Briefly, motivation can
be concluded as a combination of personal factors, social environment and cognitions interacting with each other (ibid., 24).

Incentives are closely linked to motivation: they shape the behavior. Rewards used as incentives may be economic, social or they may concern a person’s self-esteem: for example more salary, promotions or profit sharing (such as company shares) can be offered. Money is common but contradictory as an incentive: if the compensation for a work is too generous, people may lose their interest and avoid working harder. (Jensen 1998, 201–202). In expert organizations, the best incentives to enhance the motivation are usually peer recognition, possibilities for learning and enhancing independency at work (Sveiby 1997, 68). A good and inspiring atmosphere creates a shared passion and joy (Liukkonen & al. 2006, 62).

**Commitment**
Commitment is a positive involvement, an intellectual and emotional engagement. It depends on external factors, basic value commitments and personalities of the participants. It is important to realization of a plan or attain the set goals as it ensures consistency and constancy. (Etzioni 1961, 9–13; Brunsson 1985, 72–74; Hamel & Prahalad 1994, 38–40; 315). In the context of organizations and their strategies, commitment is “the tendency of strategies to persist over times and the tendency of organizations to persist with their respective strategies” (Ghemawat 1991, 14).

It should be kept in mind that expectations, motivation and commitment are interrelated with each other: lack of one influences the others (Brunsson 1985, 174). The motivation is thus a prerequisite for commitment which for its part is needed to obtain the best possible results. A motivated person is committed to his/hers work and thus efficient as a worker.

**Competition**
The competition is not always between organizations but it may also be internal, among the different departments or divisions of an organization (Hamel & Prahalad 1994, 221–222). Competition between coworkers is nowadays typical in many organizations. It may be
harmful or a positive phenomenon when giving people extra motivation to complete their tasks successfully.

3.2 Strategy

The term strategy originates from the Greek word “strategeos”, meaning a general set of maneuvers carried out to overcome an enemy. The focus is on general and not specific set of maneuvers (Eden & Ackermann 1998, 3). In the business world, the roots of the conscious strategic thinking and research date back to the end of the 1950’s (Drucker 1954, Ansoff 1965). Since then the concept of strategy and related theories have expanded, diversified and developed constantly. In the management research literature strategy has been given countless definitions and metaphors. Most definitions of strategy include elements inside and outside the organization. For example, strategy can be seen as a way for an organization to follow, as a map that leads the organization to its goals or as a process or a ladder.

An established definition of strategy is the determination of the long-term goals and objectives and the adoption of courses of action and the allocation of resources necessary for carrying out these goals (Chandler 1962, 13). Strategy combines the mission, goals and objectives as well as the capacities the organization possess (Methé & al. 2000, 51). One must predict the future: reacting to changes is not enough, let alone being satisfied with the current situation (Hamel & Prahalad 1994). Nowadays the use of the word strategy is imprecise (Hambrick & Fredrickson 2001, 49) and only few managers are able to describe briefly the strategy of their organization (Collis & Rukstad 2008, 82). For enterprises the strategy can be seen as a way to integrate the activities of different functional departments within a company (Porter 1991, 96).

Strategy is not so much about optimizing standard problems as about finding heuristic solutions to problems that have become complicated – often deliberately – beyond the point of optimization (Schoemaker 1990, 1178). The breadth of the concept can be demonstrated by the definition that “strategy is doing the right things as contrasted with doing things right”, that is organizational effectiveness is more important than organizational efficiency
(Toft 2000, 1). It is also noted that formulating strategies is often easier than implementing them into the practice (Ghemawat 1991, 4).

According to Hofer and Schendel (1978), a strategy describes the fundamental characteristics of the match that an organization achieves among its skills and resources and the opportunities and threats in its external environment that enables it to achieve its goals and objectives. Hambrick and Frederickson (2001) distinguish five essential elements of strategy: arenas, vehicles, differentiators, staging and economic logic. Strategy is the plan of allocating resources in function of the demand, whereas structure is the design for integrating the resources the organization possess with current demand (Chandler 1962).

Hamel and Prahalad (1989) use the concept “strategic intent” to describe an all-embracing will to win, to achieve organizational goals in a very long time horizon of 10–20 years. They were inspired by the Japanese-style management and organization culture and provided the strategic intent to stretch the organization capabilities and available resources over what could be expected. The strategic intent is thus stable over time and thus in a way above the strategy. (Ibid.).

Collecting every single definition by which strategy has been defined during the decades is not indispensable for this study. As our very limited glance demonstrates, strategy can mean almost anything – or next to nothing, depending on context. It is unclear whether the concept of strategy can even be used outside business environment. For example Porter (1998) talks about companies and firms, without mentioning nonprofits or public organizations. Of course, talking about the “competitive advantage” or “being the market leader” (ibid.) is hardly relevant for an organization which is not competing in markets.

The strategy as a concept is more or less axiomatic nowadays in organizations. A strategy can be supposed to be found in every organization under examination (Inkpen & Choudhury 1995, 316). Thus, as a rule, every organization should have a strategy. The strategy can be formally expressed or silent but still observable by actions and decisions the organization makes (Hatten 1982, 89).
Strategy can be understood by five P’s, which equal to five different points of view. Strategy can be seen as 1) a beforehand intended plan, 2) as a ploy against the competitor, 3) as a pattern realized afterwards, 4) as a position compared to the environment or 4) as a perspective. (Mintzberg 1987, 11–16).

Correspondingly, strategy can be divided in three forms by its manifestation: intended, emergent and realized strategies. Intended strategy is planned beforehand; emergent strategy is not planned but may arise if the original strategy is not applicable or does not include a special case or circumstances, or if it is replaced. A realized strategy is a combination of intended and emergent strategy; it is an outcome, “what really happened”. (Mintzberg & al. 1998; Inkpen & Choudhury 1996, 670). On the other hand, some intended strategies never become realized and in that case, they are called unrealized strategies (Mintzberg 1987, 13–14; 2007, 6). We will later discuss these forms and their intricacy more in depth.

Based on the literature presented before, we can summarize the concept of strategy as following. It is having intended long-term goals and objectives; being aware of strengths and weaknesses the organization possesses, as well as opportunities and threats it faces; allocating the available resources and acting, preferably proactively, in the most efficient and effective way to obtain the set goals. However, we soon face the problem that in most cases, strategy can not be very far-reaching. For most organizations, the definition includes factors that can not be predicted or even defined over a long term and thus, the strategy need to be updated on a regular basis or seen as an ongoing process. Making strategy can be seen as a process in which acting and thinking alternate (e.g. Canales & Vilà 2001, Santalainen 2006).

### 3.2.1 Ten Schools of Mintzberg

Mintzberg & al. (1998) have grouped different theories of strategy into ten categories or schools which are 1) design school, 2) planning school, 3) positioning school, 4) entrepreneurial school, 5) cognitive school, 6) learning school, 7) power school, 8) culture
school, 9) environmental school and 10) configuration school. The schools are presented in the following according to the descriptions by Mintzberg & al. (1998).

The **Design School** developed in the 1960’s. According to its representatives, the strategy forming is about reconciliation of inner strengths and weaknesses and of outer threats and opportunities. The two influential writers of this school were Philip Selznick and A. D. Chandler (Mintzberg & al. 1998, 23–46).

The **Planning School** was born in the 1970’s having as perhaps the most prominent representative Ansoff (1965, 1979). The planning scholars assume that strategy is planned by experts in a formal process that tries to predict scenarios of possible situations, actions and reactions and their causalities. (Mintzberg & al. 1998, 47–80). Planning has later been accused to be complex and formal, thus an inadequate way to see strategy, as it leaves little room for flexibility and creativity (e.g. Mintzberg 1994; Hamel & Prahalad 1994, 309–310; Brown & Eisenhardt 1998, 158). It is estimated that just having a planning system of any kind “allows the managers to sleep more peacefully, even if it really does not work” (Hofstede 1980).

The approach of the **Positioning School** was used by the military strategists such as Sun-Tzu and Clausewitz (85–91). Later, the approach was used for example by Porter: a strategy is created analytically and questions of content are more essential than in the Planning School views. An idea of this school is to protect the organization’s business and to create entrance barriers in the sector the enterprise operates (Mintzberg & al. 1998, 100–106; Porter 1998). The approach is also used by consulting companies (93–99). The Positioning School dates back to the 1980’s. It is criticized to be too narrow an approach, if other points of view are not also taken into account (Hamel & Prahalad 1994).

A famous representative of the **Entrepreneurial School** is Schumpeter and his successors. The strategy formation process is seen as a visionary process committed by the management. An entrepreneurial vision, seeing and seizing an opportunity is the core of this school. (Mintzberg & al. 1998, 124–147).
For the **Cognitive School**, the strategy formation is a mental process. The approach is individualistic and the cognitive psychology is exploited in order to create a successful strategy. Argyris and Schön (e.g. 1978) are the most prominent cognitive scholars with their ideas about learning organization and single and double loop learning. It is assumed that strategy is too complex to be formulated at once and therefore, it can only be done with little steps in a continuous learning process. With the process, a culture seeking everlasting progress and improving is created. (Mintzberg & al. 1998, 150–173).

The **Learning School** sees the strategy typically as incremental or emergent process which takes time. The strategy can be defined also afterwards by analyzing patterns and actions the organization has taken. Besides Mintzberg prominent authors of this school is Quinn (e.g. 1980) as well as Nonaka and Takeuchi (1995) with their ideas of knowledge creation as a spiral exploiting both tacit and explicit knowledge. (Mintzberg & al. 1998, 176–231).

According to the **Power School**, the strategy is a negotiation process between the stakeholders, trying to impose their views and gain the power. There are political games both inside and outside organization trying to have impact on it and people form coalitions and alliances to get their own aims to realize. (Mintzberg & al. 1998, 234–261).

In the **Culture School** the strategy formation is a collective process creating dialogue and a common model of thinking. It is an interactive experience, directed to produce a organization-wide sensation of identification. Culture, values and strategy are closely linked with each other. (Mintzberg & al. 1998, 264–283).

The **Environmental School** emphasizes the effect of external factors to the strategy. The environment encumbers the organization and the strategy is formed as a reactive response to these externals factors. (Mintzberg & al. 1998, 286–300).

The **Configuration School** combines elements and views from the previous schools. On the one hand, it seems the strategy as a change process and the strategy formation and strategy renewal occur as a strategic change is made in the organization or as the organization enters
a new phase. On the other hand, organizations differ from each other and thus, different aspects of strategy must be emphasized in different organizations. The typical characteristics of every organization must be taken into account. Thus, the strategy concept is not universally applicable but the emphasis must be chosen according to the organization in case. Other organizations may profit from exact planning beforehand whereas the entrepreneurial starting point may be more beneficial to the others. (Mintzberg & al. 1998, 302–347).

The most recent ideas of Mintzberg start from the assumption that a strategy must be formed by taking into account these organization-specific characteristics (Mintzberg 2007). He has also earlier criticized the concept of strategy as highly detailed planning and ignoring other points of view (Mintzberg 1994).

3.2.2 Strategic Management

If strategy is an ambiguous concept, so is strategic management, too. It is the process that determines and maintains a viable set of relationships between the organization and its environment, and seeks to systematize the evaluation of organization performance (Hatten 1982, 89–90). Strategic management sets directions for the organization’s long term development and explicitly matches strategies and situations in an active administrative process (ibid.).

Strategic management is a way of regenerating an organization, through continuous attention to the vision people in an organization wish to realize. It is a pro-active process of seeking to change the organization, its stakeholders and the context or “environment” within which it seeks to attain its aspirations (Eden & Ackermann 1998, 3).

Strategic management is about integrating strategic planning with other dimensions of the administration, execution of the strategies and their evaluation and the overall strategic thinking (Toft 2000, 4). Two types of strategic management models can be distinguished: 1) the synoptic model and 2) the learning, adaptive or incremental approach (Methé & al. 2000, 32). The previous emphasizes the planning beforehand where as the latter sees
strategic management as more flexible, taking into account organization specific situations, the stakeholders as well as the organizational and human capacities (ibid.).

As the concept of strategy has evolved in the course of the past decades, so has strategic management, as at least seven different “the best way” approaches can be distinguished (Toft 2000). The strategic management of today pays attention to the people. Motivation, well-being and empowerment of the personnel are more central today than they used to be (ibid.).

3.2.3 Case of Public and Nonprofit Organizations

Strategy and strategic management are widely researched concepts in private sector since the 1960’s. The need for strategic thinking and management expanded and the idea of adapting them to the public sector was introduced in the late 1970’s (see for example Hatten 1982, 89; Wortman 1979, 353). Already in that period the special characteristics and needs of public and nonprofit organizations were acknowledged to differ from those of for-profit organizations. Still, twenty years later strategic planning scholars felt it really was too early to draw any conclusions concerning the applicability of strategy concepts in nonprofit organizations. (Stone & Bryson 2000).

There are opinions for and against of applicability of for-profit strategic management techniques into nonprofit organizations. Early in the 1980’s it was estimated that both public and nonprofit organizations can benefit from the concept of strategic management (e.g Hatten 1982). It was noted that differences in the raison d’être of organizations should be taken into account. Concepts of strategy and strategic management should also be adapted to organizations on a case by case basis. The management of nonprofit organizations is dispersed to political and administrative stakeholders and thus a strategy provides a common tool or language to develop the organization. (Hatten 1982, 89, Bryson 1995).

Halachmi (2000) claims that strategic analysis differs for private and public organizations, because threats, opportunities and strengths are not defined in the same way. For example,
a new company in the same branch may be a threat for a company, whereas for a public organization it may be a positive issue. Also the numerous stakeholders of public organizations and political ambitions may complicate strategic thinking and management in public organizations, especially when people in charge want to shape organizations for their own purposes. (Halachmi 2000, 357–359; 363–365). The opposing point of view claims that judging public sector against a normative model of strategic management in the private sector will give insufficient results (Ring & Perry 1985). In any case, public sector deals with some same issues that the private companies, such as limited resources, competencies and quality. Strategic management is thus needed also in the public organizations. (Santalainen & Huttunen 1993).

In public sector, the terms “strategic planning” or “strategic audit” are more widely used than “strategic management” (Toft 2000, 4–9). However, strategic planning, management, thinking or pure strategy are not the same things and they shouldn’t be used as synonyms. Planning implies more analytical and even mechanical process, whereas strategic thinking requires not only analyzing but also synthesizing. (Mintzberg 1994, Santalainen 2006).

Public management has undergone a renewal process inspired by business models, including concepts such as accountability, profitability, strategic planning and so on. The most famous of these doctrines is the New Public Management (NPM), which started at the beginning of the 1980’s in the USA and in the UK. The NPM spread out effectively and it has been adapted into public sector management in several countries, with more or less successfully. NPM has been seen as “a triumph over bureaucracy”. (Pollitt 2003, 32–33). NPM doctrines include elements that are also of concern of strategic management, such as better administration, strengthening accountability and paying attention to the human resources (Pollitt & Bouckaert 2004). The same relates also to other management reforms that have been committed in Europe recently (Bauer & Knill 2007; Peltonen 1999; Tiihonen 1998). These reforms are however more of administrative than strategic nature.

The NPM and its application have been studied widely both on national and international level, by comparing experiences in different countries (see for example Pollitt & Bouckaert
A blind spot in organizational studies has instead been the research on organization and management of international nonprofit organizations, even though they have otherwise been subject of many studies for a long time (Bauer & Knill 2007, 11).

The Reagan Administration in the USA adapted the NPM thinking and executed major structural reforms in the US government. They also had a notable effect on the UN institutions by encouraging administrative reform and greater efficiency in UN institutions. (Geri 2001, 451). Of six UN agencies studied by Geri, only WHO undergone substantial organizational reforms, but still falling short of implementing the entire NPM package. The data obtained from the organizations was not completely comparable, but it is evident that the organizations face internal and external pressures to modernize their activities. A trend in these organizations is to establish or strengthen relations with the private sector. (Geri 2001).

There is no evidence in the literature suggesting that strategic thinking and strategic management could not be used or they wouldn’t be beneficial in nonprofit organizations. It must be kept in mind that even though most organizations can benefit from improving their practices and management, there is not one best practice applicable even for business organizations (Harrington 1997, 62–63).

Acknowledging that all strategy definitions are not compatible across all organizations is not saying that strategy itself is inapplicable with any organization. The crucial question is the definition of the concept of strategy. Therefore, even though everybody was supposed to know what strategy is, the concept should always be defined before applying it.

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4 ITU, WHO, WIPO, FAO, ILO and UPU
5 The WHO reform took place during the directorate-general of Gro Harlem Brundtland in the turn of the last decade. The theme of the reform was “One WHO” and it concerned budgetary reorganization, the reallocation of funds, restructuring of the WHO organization and its managerial processes, and amending the outbound relations. (Lerer & Matzopoulos 2001)
3.2.4 Strategy Absence

Based on the above strategy discussion, it is therefore highly probable to find a strategy in an organization studied. The strategy can either be explicit, when it is clearly outspoken or codified, or implicit, when it can be observed by the patterns of actions and decisions the organization takes in different situations (Inkpen 2000, 277; Porter 1991, 1998). It is, however, unclear at what point a series of decisions and actions can be called strategy (Inkpen 2000). A strategy absence can be observed if the appearance of strategy is expected but can not be found (Inkpen & Choudhury 1995, 313). According to some theories, strategy is not necessary in every organization, but not having it has several disadvantages (Ansoff 1965, 112–115).

The strategy absence can be seen resulting from three possible reasons: 1) as a negative concept, originating from a managerial failure, 2) as a transitional concept in an organizations lifecycle and 3) as a positive concept; a phenomenon in its own right (Inkpen & Choudhury 1995, 316). However, not even Inkpen and Choudhury are willing to instill a new paradigm of strategy absence. Instead, they want to state the legitimacy of interest in the concept of strategy absence and remind that the concept of absence may help strategy researchers better understand existing paradigms (Inkpen & Choudhury 1996, 669–670).

However, it should be kept in mind that poor performance and strategy absence are not synonyms. Rather, the former is a consequence of an inefficient strategy (Inkpen 2000, 276). Thus, if a company is performing insufficiently it may well have a strategy but the strategy has failed. On the other hand, an organization can well perform without having a strategy. The absence of strategy can be as vital as its presence (Mintzberg & al. 1998, 18).

Theories of strategy assume that the strategy and the structure of an organization are interdependent: the structure is derived from the strategy (Chandler 1962). If the strategy and structure are not coherent, the organization will not obtain the optimal results (Donaldson 1987). An organization can typically not function without any strategy (Mintzberg & McHugh 1985, 196). Even so, business managers sometimes claim that their
organization do not have a strategy at all (Collis & Rukstad 2008; Hambrick & Fredrickson 2001; Brown & Eisenhardt 1998).

A strategy can be constructed afterwards by seeking actions and patterns that represent the organization strategy. This is called an emergent strategy and as stated before, it is usually a component of the realized strategy (Mintzberg & al. 1998, 12; Mintzberg & McHugh 1985, 162). Ideally, strategies should be examined over time since the impact of strategy becomes visible only after a while (Nath & Sudharshan 1994, 38).

**Strategy Absence in the Public Sector**

The absence of strategy or strategic action in public organizations is not necessarily an evidence of incapability of to think or act strategically. For example, on the governmental level ministers are not trained to be strategist. They may well learn the rhetoric but the strategic action is not apparent. (Pollitt & Bouckaert 2004, 140) In a study made of the Finnish government it was discovered that ministers do not act as strategic leaders even if they possessed the capacities, as it might harm their career (Puoskari 2002; Tiili 2007). As politicians, they are obliged to prioritize their career and the next elections whereas acting as strategic leaders is a more long-spanned activity (ibid.).

On the other hand, some claim that as nonprofit organizations often have plural, ambiguous and even conflicting goals and several stakeholders, an explicit vision or mission statements (and thus, strategy statements) are not always needed (Stone & Bryson 2000, 757–758). In such cases, it may be enough to have more general goals, missions and visions instead of detailed strategy, in terms to keep numerous stakeholders pleased (ibid.).
4 High Energy Physics, CERN and ATLAS

Before having a closer look on the organization under study, ATLAS, we will now present the field of High Energy Physics, including the people working in it. The following description of the field and its characteristics is simplified because of the limited scope of this study.

High Energy Physics (HEP) also known as experimental particle physics exists to enhance the knowledge about the early Universe and its basic building blocks, namely matter. Compared to many other fields of science, the number of the HEP researchers is modest (only about 11 000 researchers which equals to size of a small town). Particle physics is basic research, without any direct practical or commercial applications (Pickering 1984, 22). The field is special because of the resources needed: modern particle physics research exploits gigantic devices, designed, built and operated by the scientists themselves.

Chompalov & al (2002, 751) summarize special features of particle physics presented in previous literature as: 1) a specific culture within this community, 2) two traditions of doing particle physics science – the use of devices to generate “golden images” of events and the utilization of computational techniques to establish logic in the quantitative data, and 3) the characterization of collaborative experiments in HEP as post-traditional communitarian formations.

4.1 The World of HEP

There are two main branches in HEP, theorists and experimentalists. The theorists work mainly at blackboards in small groups whereas experimentalists form large collaborations that last many years (Traweek 1988, 3).

The experimentalists need two types of devices to carry out their research: accelerators and detectors, or experiments. These days, they are gigantic and complex machines, consisting

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6 A relatively easy approach to the field for a non-physicist is for example a book “Constructing Quarks” by Andrew Pickering (1984).
8 Chompalov & al. note that the first feature is from Traweek (1988), the second from Galison (1997) and the third one from Knorr-Cetina (1998).
of several subsystems and many different technologies. The modern particle physics detectors are among the biggest and most complex machines ever built. For example, the biggest experiment in size at CERN, ATLAS, stands as tall as a five–floor building with the height of 30 meters. Its length is 46 meters and it weighs some 7000 tons, which is equivalent to the weight of the Eiffel tower. (Liyanage & al. 2007, 71). The detector is situated in a tunnel some 100 meters underground.

Accelerators employ electric fields to accelerate stable charged particles, i.e. electrons, protons or ions to high energies (Perkins 2000, 338–339). The development of accelerators is essential for the field, as the higher energies are required to make new findings (Peccei & al. 1995, 14). The accelerators can be classified by their form (linear or circular in shape), by the particles they use\(^9\) or by the temperature in which they work (room temperature or superconductivity, i.e. close to the absolute zero) (Hartill & al. 1995). Most of modern accelerators are circular in shape and thus called cyclic accelerators or synchrotrons (Perkins 2000, 343).

The accelerated particle beams collide inside the experiments. Several different measurement techniques are used. Big modern detectors are composed of layers of detectors similar to the construction of an onion (Bensinger & al. 1995). In a collision the incoming particles decompose into new ones and scatter the detectors which track their traces and measure the speed of the dispersed new particles. These traces generate a vast amount of information which will be processed later on all around the world.

Modern HEP devices are huge in size and their designing and building takes years, requiring expertise in many fields of engineering. The devices face extreme circumstances, as they have to support near absolute zero temperatures, outer-space vacuum, strong magnetic and electronic fields as well as high localized radiation levels.

\(^9\) The particle pairs collided in the accelerators may be for example electron–electrons, electron–protons or proton–protons.
The devices are crucial not only for the advancement of science but fostering the scientific community as well. First of all, they are unique and customized, designed, built and operated by their users, unlike laboratory facilities in general. Second, it is claimed that in HEP research, the devices constructed shape the organization of scientific research and even the research questions. They are not seen only as machines but also as key informants. (Traweek 1988, 17; 49). Third, designing and building a detector is such an intensive and time-consuming process that it affects also on researchers’ identity and their lives outside the work. The coexistence of humans and machines becomes a symbiosis (Knorr–Cetina 1998, 129; Traweek 1988, 84).

4.1.1 Collaborations in HEP

A definition of scientific collaboration is “human behavior among two or more scientists that facilitates the sharing of meaning and completion of tasks with respect to a mutually shared superordinate goal and which takes place in social context” (Sonnenwald 2007, 3). Different kinds of collaborations exist throughout the sciences (Chompalov & al. 2002).

In the field of High Energy Physics, collaborations are like a basic unit because of the resources and equipment needed. They are quite unique organizations, as they are strongly based on personal relations between the researchers. HEP collaborations are often characterized by words such as consensus, democratic decision-making, flat structures, being highly egalitarian and based more likely on mutually recognized memoranda than legally binding documents (Chompalov & al. 2002). A definition to HEP collaborations is a “movable, semi-detached corporations located somewhere between a social movement and an organization in the vocabulary of social categories, but identical with neither” (Knorr–Cetina 1994, 123). ATLAS as collaboration is loosely coupled network of independent research institutions without traditional structures, which makes it a very typical example of a research organization in HEP (Tuertscher 2008, 11).
There are only a few research centers\textsuperscript{10} in the world equipped with such large-scale particle accelerators. Thus, the number of simultaneously performing big experiments is limited. As money and manpower are scarce resources, the physicists form collaborations in order to collectively design, build and operate experiments. The basic scheme is that the host laboratory offers the accelerator facilities and the collaborations are responsible for the experiments. (Morrison 1978, Krige 1991, Traweek 1988, Knorr–Cetina 1998).

The size of collaborations has evolved during the years. At first they consisted of a few dozen of researchers. In the 1970’s it was estimated that the size of a collaboration should not exceed 500 people to assure that people would know each other at least by face or name (Morrison 1978, 8). Nowadays, large collaborations involve several thousands of people. For example, ATLAS and CMS collaborations at CERN consist both of some 2100 researchers.

New collaborations emerge often quite spontaneously, based on previous collaborations and cooperation\textsuperscript{11}. At the beginning, there may only be a few eager scientists who share a common vision of how an experiment should be built. Genuth & al. (2000, 315; 317) distinguish four major factors affecting on the formation of scientific collaborations: 1) the interpersonal context, 2) the donor context (the availability of patrons and the fiscal and political in which such patrons operate), 3) the sectoral context (relations among academic, industrial and governmental sector), and 4) the home-organization context (national and international research institutes). Genuth & al. state also that there are four types of members of collaborations: university departments, university institutes not affiliated with a single department, independent research institutes and corporate research laboratories (ibid.).

\textsuperscript{10} The most notable ones in alphabetical order are: Brookhaven National Laboratory, located on Long Island, USA; Budker Institute of Nuclear Physics in Novosibirsk, Russia; CERN, located on the French-Swiss border near Geneva; DESY, located in Hamburg, Germany; Fermilab, located near Chicago, USA; KEK The High Energy Accelerator Research Organization of Japan located in Tsukuba, Japan and SLAC, located near Palo Alto, USA.

\textsuperscript{11} Forming and the “birth” of the HEP collaborations are often fascinating stories about determination, scientific curiosity and cooperation and concurrence with competing experiment proposals. We are unfortunately obliged to omit a closer look and research on this intriguing subject from this study. For more, see for example Knorr-Cetina (1998, 193–196) and Genuth & al.( 2001).
In any organization there must be a consensus on organization’s general values, goals, means, politics or tactics, conditions of participation and performance obligations (Etzioni 1961, 129–130). This naturally applies to collaborations in HEP. Participation in a given experiment and joining the collaboration requires that one is in agreement with its goals and basic working principles and scientific assumptions. The experiments vary in their research scope and selection of technologies. Joining one experiment instead of another can be seen as showing a preference or a position\textsuperscript{12}. The consensus is especially needed in the beginning of a new collaboration when the most fundamental decisions about technologies are made (Knorr–Cetina 1994, 121).

The consensus needs not to be perfect. However, everybody must accept the common goal, the means the collaboration adopts to attain the goal and the (hidden) assumptions or proposed theories that shape the collaboration activities. The common goal and presuppositions behind it can be called as a group belief. (Staley 2007). The degree of consensus reflects the integrity of the collective (Etzioni 1961, 128). Collaborations could thus be seen a bit like clans, sects or political parties who share the common beliefs and the philosophy of life.

As any organization, the collaborations must be organized due to their size, time constrains, volume, variety of data and the sheer number of people. There are similarities with business organizations in terms of planning, coordination, division and internal hierarchies, but equity fails as the scientists tend to regard and treat each other as professional equals. (Krige 1991, 10). Managers and leaders face same challenges as their colleagues in any expert organizations but the collaboration structure, a bunch of equal partners, differs from more traditional structures. The administrative and scientific management are in some cases separated and sometimes taken care of by the same person (Chompalov & al. 2002; Sonnenwald 2007; 14).

\textsuperscript{12} Having said that, some universities participate in two or more experiments at same time, so making a choice is not always that fundamental and irreversible.
4.1.2 Researchers in HEP

The role of the scientists in the experimental physics is multifaceted. On one hand, (s)he is like an autonomous craftsperson and on the other, like a factory-worker (Chompalov & al. 2002, 749; Krige 1991, 3). Like any work exploiting the intellectual capacities, the scientific work is knowledge-intensive and the characteristics describing the experts and expert organizations earlier apply on the researchers as well in general as to the HEP.

In the industry, many researchers tread a fine line between professional and organizational identity. The final locus of identification may be 1) the organization (the person feels oneself first and foremost as a member of the organization (s)he works for; 2) the scientific community (the feeling of belonging to the scientific community), 3) both organization and scientific community, or 4) neither of them. (Zabusky & Barley 1997). The same applies also to experts of any kind in general: they often feel alienated from the organization they work for (Temmes 1992, 127).

The personal relations are essential characteristics of the relatively small HEP community. It is not surprising that most people know each other at least by names or by having common acquaintances. There are only few major international laboratories in particle physics and many researchers work during their career in more than one of them, or at least for different experiments. The American English is the lingua franca of the field (Traweek 1988, 144).

Another factor to facilitate the cooperation is a high interpersonal trust between the scientists (Traweek 1988, Knorr–Cetina 1994; 1999). Knorr–Cetina (1998, 165) describes the high energy physicist communities as post-communitarian structures, which emphasizes collective work instead of individual work contribution and which is not based neither on altruism nor communality. Because of variety of cultures, languages and nationalities, these researcher communities are however “communities without unity”, as Knorr–Cetina cites Corlett (ibid.). Trust affects also on knowledge sharing: the past behavior and the expected action have been noted to be the most important factors in scientists’ considerations, whether to share information with colleagues or not (Ensign & Hébert 2005).
Knowing each other, the personal relations are of high importance and interpersonal trust is an essential element in order the cooperation to go smoothly and the work progressing. Davis & al. (2000, 564) summarize the essentials of the existing literature. They note that trust and organizational success have long been linked together; trust reduces transaction costs, the need for many forms of control and opportunistic behavior. It is always unique and can not be copied and it is also rare, especially between employees and management. Davis & al. also prove in their own study that there is a correlation between trust and organizational performance, and the trust can – and must - be built (ibid.).

But what is trust? An established definition is that of Mayer & al. (1995, 712):

*Trust* is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party.

Two factors are thus inseparable: vulnerability and risk-taking. As one can not control the other, the only choice is to believe and hope that his/her action will someday pay off. Knorr–Cetina (1994, 128) notes that due to the mutual trust, people self-regulate their behavior in a way that supervision and control become unnecessary.

Krige (1991, 24) concludes that satisfaction of the HEP researchers boils down to playing with new idea; enjoying quality of life in the collaboration, having personal and meaningful relationships with colleagues and sharing the atmosphere combining individual and collective aspects.

As the work is done together, so are the most important publications, too. An established practice in HEP research is that publications are made in the name of the whole collaboration and the list of authors may include hundreds of names, listed in alphabetical order or sometimes grouped according to the institutes (Knorr–Cetina 1998, 167; Aihara &
al. 2006). This may be frustrating and result in feelings of injustice, not only among the researchers but also among the technical staff. All of them are not included to the authors list but their contribution may in some cases be crucial. (Morrisson 1978, 9–11). Another point of view is that of intellectual property rights (hereinafter referred as IPRs). Questions related to them have been not been treated much but the interest in these issues is growing (Sonnenwald 2007).

According to Krige (1991, 15–19) there are three ways to gain credit in the field of HEP: 1) publishing in the referred literature, 2) speaking at conferences and 3) impressing colleagues with diligence and professional competence. The publications having the whole collaboration as authors may not accord the credit to all of those who would deserve it. Several mechanisms have been proposed to solve this problem, but no major reforms have been planned (Aihara & al. 2006).

Even if there might be friendly rivalry between colleagues, they are still treated as friends and helped (Morrison 1978, 13). On the other hand, even excellent ideas are futile if one does not share them with the others as no one can realize experiments all alone (Krige 1991, 19; Traweek 1988, 17). There must be a balance between individuality and collectivity. In order to face collectivity, a person must have both space for individuality and means to express it. Thus, when encouraging individuality, one also strengthens collectivity. (Koivunen 2005, 42; Krige 1991, 24).

Communication and the time used for it are not insignificant. According to a study, a third of a researcher’s time is spent on communication (Deutsch 2007). The frequent Collaboration meetings, visits and telephone calls are as important as they were in the past days (Morrison 1978, 6) but letters have been replaced by e-mails, video-conferences, internet and the ATLAS wiki\(^\text{13}\). Besides the big Collaboration meetings, there are uncountable amount of other meetings and sub-meetings on every level of the organization. (Knorr–Cetina 1994, 131).

\(^{13}\) A wiki is “web-based software that allows all viewers of a page to change the content by editing the page online in a browser. This makes the wiki a simple and easy-to-use platform for cooperative work on texts and hypertexts.” (Ebersbach & al. (2006, 10).
The shared information is not only formal and related directly to work but also informal, like news and rumors or knowledge that is not yet published (Morrison 1978, 7). The latest scientific achievements are not read in books and papers but well beforehand, as the reports and other documents circulate within the community (Knorr–Cetina 1994).

In decision-making, two aspects can be distinguished: it may be an occasion in which certain conclusions or choices are made, or a process during which the state of affairs is changed (Knorr–Cetina 1994, 135). In HEP experiments, the decision-making is often more or less a ritualistic approval, as the decision is de facto emerged beforehand during the discussion or the preparation process (ibid.).

4.2 CERN

CERN, the European Centre for Nuclear Research is one of the oldest co-European undertakings. CERN dates back to 1954 and it has carried out successful particle physics activities ever since. It is classified as international organization for scientific purposes, having 20 Member States, eight Observers and several other countries involved in its activities. The members of CERN are thus state governments.

Today CERN is one of the leading scientific institutes in particle physics research. It is a multinational organization, formed and financed by its Member States. The research made there has directly contributed to more than five Nobel Prizes. At the moment, researchers at CERN are discovering fundamental particles that are smaller than atoms. The aim is to unlock the secrets of the universe and matter, for example, what happened in the Big Bang some 14 billion years ago.

14 The Member States are: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Spain, SwEden & Ackermann, Switzerland and the United Kingdom. Observer States and Organizations currently involved in CERN programs are: the European Commission, India, Israel, Japan, the Russian Federation, Turkey, UNESCO and the USA. Non-Member States currently involved in CERN programs are: Algeria, Argentina, Armenia, Australia, Azerbaijan, Belarus, Brazil, Canada, Chile, China, Colombia, Croatia, Cuba, Cyprus, Estonia, Georgia, Iceland, Iran, Ireland, Lithuania, Mexico, Montenegro, Morocco, New Zealand, Pakistan, Peru, Romania, Serbia, Slovenia, South Africa, South Korea, Taiwan, Thailand, Ukraine and Vietnam. http://public.web.cern.ch/public/en/About/Global-en.html. Data accessed on June 5th, 2008.
CERN exists purely for peaceful scientific nuclear research by its Convention (Peaslee 1979, 80). It is quite a unique undertaking as the initiative to form a multinational European research centre for particle physics came from the scientists, not from the politicians, though political support was needed (Pestre & Kriege 1995, 40–42). National or military ambitions were not involved and the project was “de-ideologized” from the very beginning. The European armies were aware of the project but indifferent to it. (Ibid).

The scientists have played the major role at CERN ever since both in scientific and administrative issues. Compared to many other international joint undertakings, CERN has been able to influence the representatives of its member states more than vice versa. (Pestre & Kriege 1995). This means that CERN has largely been able to convince the national representatives to act in a favorable way regarding its own aims, and to avoid the pressure coming from the national authorities. In other words, despite the control imposed by the member states, CERN has well maintained its autonomy in regard to them. However, Pestre and Kriege note that CERN could not be taken as a model or seen as an ideal situation (ibid).

At the moment, a new accelerator, LHC (Large Hadron Collider), is just completed at CERN. It will start accelerating sub-atomic particle beams to almost the speed of light with energy of 7 TeV each in a circular tunnel of 27 kilometers long. The particle beams circle in the tunnel in opposite directions over 11 000 time per second before colliding with each other with 14 TeV of energy. Each beam is well-defined and composed of almost 3000 particle bunches, each containing about 10^11 (a hundred billion) protons. (CERN 2008, 34–35). The LHC machine is scheduled to start in autumn 2008, as well as all the six detectors.

In science, if the results are to be validated, the experiments must be repeatable by other researchers. In order the results to be reliable they must be coherent with the findings from other experiments. There are six detectors, also called experiments at CERN at the moment, each having a slightly different research focus. The two largest experiments, ATLAS and CMS, are capable of searching for a wide range of particles. ALICE and LHCb are middle-size experiments, whereas TOTEM and LHCf are much smaller in size. The experiments
are relatively independent organizations inside CERN with their own budgets and organization structures. They are not only carrying out their own research but they also attempt to verify findings made by the other experiments whenever possible.

The main purpose of the LHC and its experiments is to enhance our knowledge about the Universe and matter. A principle aim is to find the Higgs boson, which would complete the Standard Model and enhance understanding about questions such as to where elementary particles get a mass and why their masses vary between each other. These questions are closely connected to the secrets of the Universe and matter. However, some important innovations made originally at CERN have also become a part of our everyday life. Probably the most known and the most widespread example of such innovations is the World Wide Web (WWW), the most used service at the internet (Gillies & Cailliau, 2000).

LHC with its experiments has been the “center of the gravity” of the HEP research for many years and will remain so. This has meant that a remarkable part of resources available for the HEP research have been allocated to CERN and to the LHC experiments. At the moment CERN is one of a kind in HEP. The results provided by the LHC and its experiments will strongly influence what will be the most prominent subjects of research in the post-LHC era. The existent theories will be proved right or abandoned and that will determine the future of the field.

CERN has been the focus of the HEP research for many years and will still be it for several years not only because of the scientific output but also because of the funding. The hegemony of CERN may easily create tension between research institutes. On the other hand, for example the USA has cut the budget allocated to basic research which has caused severe problems for research institutes there, such as Fermilab and SLAC. The positive aspect from the CERN point of view is that in such a situation, it has tempted the talented researchers to come to CERN.

The interest of media towards CERN and ATLAS has increased as the starting the LHC comes closer. As the idea of building the LHC and then the experiments dates back to the
middle 1980's and the designing and building phase have really been going on since the early 1990's, the universities as home institutes as well as other funding agencies are anxious to get results as well.

4.3 ATLAS

The name ATLAS is an acronym of words A Toroidial LHC ApparatuS. In the Greek mythology, Atlas was a giant holding the world on his shoulders. This figure is also in the logo of the ATLAS experiment. The ATLAS detector\(^{15}\) is situated one hundred meters under the ground. If hopes and expectations come true, it will enhance our knowledge about matter and the Universe in the coming years.

A visit in the ATLAS cavern is an impressive experience. Because of shoestring financing, the cavern is adapted to its purpose and there is no extra space. The experiment fills the 53 meters long, 30 meters wide and 35 meters high cavern completely. The device is not built in the cavern piece by piece, but in modules often weighing several tons, shipped to the CERN site, lowered down into the cavern and installed there.

Small and enormous go hand in hand in everything in ATLAS. The huge detector is made to examine the tiniest particles ever known and the detector is made of pieces of which the needed precision is sometimes only some micrometers. The precision has also been needed when lowering the segments of the detector to the cavern: even though the parts have weighed dozens of tons, the margins of the movement have only been some millimeters. A tiny movement would mean hitting the wall or already installed parts of the detector, which could cause a damage of millions of Euros. However, compared to its sister experience CMS, ATLAS is said to be done in pieces, as the previous is mostly made in a hall above its cavern and the parts lowered down have been much larger.

\(^{15}\) “ATLAS” is thus used in three slightly different meanings throughout this study. It may refer to 1) the detector 2) the experiment or 3) to the Collaboration. Experiment is often used as the synonym for the detector, but it may also be understood as not only the detector as a physical object but also research activities related to it.
The ATLAS-project can be divided in two phases: first, the recently finished building phase and the operational period, when the LHC machine and all the experiments will be running. The latter phase will take many years and starts in the summer 2008, when the LHC and all the experiments are ready for use.

ATLAS as an organization is interesting and unique, one-of-a-kind emergent technological system (Tuertscher 2008, 2; 11). For this study, we identify four main characteristics defining ATLAS as an organization. It is an international, scientific nonprofit expert organization in between public and private sectors. In total, there are over 1900 scientists and engineers and 200 students working for the ATLAS collaboration, from 167 institutions and 37 countries. In addition, ATLAS employs some administrative personnel.

Besides of being an international organization itself, ATLAS is embedded within international organization of slightly different kind, CERN. ATLAS is a worldwide collaboration of a group of institutes from CERN Member and non-Member States (ATLAS Collaboration 1998). CERN has a dual role in ATLAS: it is the host laboratory and supporting organization as well as a member of the collaboration. It is thus highly involved in ATLAS although both have their own management, budgets and organizational structures. The ATLAS management is currently paid by CERN and the Resource Review Board is chaired by the CERN Director of Research.

ATLAS is a scientific expert organization which is not aimed at money-making or providing any goods or services but to fulfill its scientific mission. There is no competition for market shares as for example in many for-profit organizations. Efficiency and profitability in ATLAS can not be measured by using pure economic indicators. Progress is sometimes made by stepping back by renegotiating, correcting mistakes and changing design parameters (Santalainen & al. 2007, 10; Tuertscher 2008, 43). Even though ATLAS is not a market-oriented organization, it is not immune to impact of the outside commercial world. Being a lead-customer of a wide range of materials and components, disturbance on these markets could also affect on ATLAS.
Most of people working for ATLAS are paid and directed by their home institute, even though the work is physically carried out at CERN. Only about one tenth of the people are paid by CERN or by the ATLAS Collaboration itself. A large part of the research and design work related to ATLAS is not done at CERN but there are lot of researchers conducting their ATLAS projects around the world. The situation is to a certain extent comparable to joint projects of companies, in which the work is done problem-based in a cross-organizational network organization. The aim of the work is a common one, even if the salaries of co-workers would be paid by various companies.

The organization has to cope with perpetual readjustments, concerning both the machines and the flow of people. In the building phase, ATLAS employs both theoretical and practical knowledge, some of which in very specific areas. Physicists, engineers and mechanics of almost every imaginable branch are needed as many technical devices and solutions are unique and developed only for ATLAS. This is also a reason why the project is very beneficial for the people involved, as they gain personal advantage and expertise; continuously developing their skills and knowledge by solving problems never appeared before. People are also ready to pledge oneself to temporary engagements (Knorr–Cetina 1998, 179–180) and to volunteer to accomplish tasks that need to be done, even if these tasks were of someone else's responsibility.

### 4.3.1 Organization Structure

The ATLAS organization was not formed deliberately but it emerged little by little (Tuertscher 2008). The cornerstone of the Collaboration is the Memorandum of Understanding (hereinafter referred to as MoU) which defines the Collaboration and its objectives, the rights and obligations of the member institutes and the organization of the Collaboration. However, the MoU is not legally binding but it is noted in the beginning that “the success of the Collaboration depends on all its members adhering to its provisions” (MoU, Preamble (i)). The MoU is comparable to charters of international organizations in which they define their raison d’être, rights and responsibilities among the members.

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16 The flow of people is here used to represent in the first place people from universities, who come either for a short time or occasionally to work for ATLAS at CERN. This heterogeneous group includes as well students as visiting researchers, just to name few.
The ATLAS Organization is described in the MoU and especially in its Annex 5. The principles leading the organizational structure are democracy, separation of policy-making and executive powers, minimal formal organization and limited terms of office (MoU, Annex 5.3; 1). During the years, some minor modifications on the organization have been done. The most important actors are presented in the following discussion\(^\text{17}\).

An open forum for all the collaboration people is the week-long meeting ATLAS Week, which is organized four times a year. A general meeting called Plenary Meeting (PM) takes place during the ATLAS Week. The PM is open for everybody and presentations concerning subprojects and the overall are given there. Issues to be decided together in the Collaboration Board (CB) are presented and discussed together there.

The Collaboration Board (CB) consists of representatives of the member institutes of the collaboration and the Executive Board (EB, see later) members ex officio. Every institution has one person and one vote, with an exception that larger institutions may have two representatives but still one vote. The decisions are taken by consensus or by vote. All votes except from concerning persons, i.e. elections, are open.

The Executive Board is composed of the ATLAS Management (see below), the System project leaders and coordinators, the CB Chairperson and Deputy Chairperson as ex-officio and some additional members chosen to ensure an overall balance and competence in the EB. The EB meets about once a month. It is chaired by the Spokesman, and its responsibilities include

“\(\text{(D)irecting the execution of the ATLAS project and [...] direct communication between the ATLAS management and the systems. It monitors the execution of the individual systems and discusses matters involving several systems.}\)”

\(^{17}\) The ATLAS organization structure was slightly modified for the Operation phase and some minor modifications have also been made in the course of years. However, as a whole the organization is and has been very much as presented and taking into account the subject of this study we can dismiss those minor changes in this occasion.
The Resource Review Board (RRB) is chaired by CERN Director of Research and it consists of representatives of agencies funding ATLAS and the managements of CERN and the ATLAS Collaboration.

The ATLAS management is in charge of the overall execution of ATLAS. It is a team of currently five people: Spokesperson, two Deputy Spokespersons, Technical Coordinator and Resources Coordinator.

The Spokesperson is on the top of the organization, acting as the representative of the Collaboration outside it. (S)he is elected now for two (previously for three) years by the Collaboration Board, after nomination of candidates by the Collaboration. The Spokesperson may nominate one or two deputies, endorsed as well by the CB. The spokesperson is important not only as transmitting information to and from outside community, but as the ultimate mediator between the collaboration members. The spokesman is a dominant personality (Morrison 1978, 5; Liyanage & al. 2007), but remains unclear, how much the spokesman, even if a strong personality, can actually affect on the Collaboration. The history knows at least one strong-willed collaboration spokesman having behaved in a somewhat autocratic way^{18}. This is however kind of an ultimate situation.

^{18} The spokesman in question was Carlo Rubbia, the spokesman of UA1 at CERN in the 1980’s, being famous for having little tolerance for any opposition. Finally, his leadership was awarded by the Nobel Prize in Physics in 1984. See for example Krige (1991, 15) and Taubes (1986).
The organization structure presented above describes the big picture of the organization. The entire project is divided into sub-detector structures. In Figure 1, on the lower left side are presented the subprojects, i.e. sub-detector structures. They are the Inner Detector, Tile Calorimeter, Magnet System, Liquid Argon Calorimeter, Muon Instrumentation and Trigger/Data Acquisition. On the lower right of the Figure 1, there are the coordination groups: the Trigger Coordination, the Data Preparation Coordination, the Computing Coordination, the Commissioning/Run Coordination and the Physics Coordination.

The sub-projects could be compared to vertical divisions or units of a company whereas the coordination groups present horizontal operations or processes; they consist of people coming from several subprojects. Coordination groups coordinate the shared interests and common activities of the subprojects. Another (and perhaps more clearly way) to present the ATLAS organization structure would be a matrix in which the subprojects and coordination groups overlap.

Figure 1: The ATLAS Organization as in March 2008.\textsuperscript{19}

The subprojects have up to now been more or less independent sub-organizations within ATLAS, in principle with an internal structure very similar to that of the Collaboration. They consist of home institutes (universities). One home institute may be participating in several subprojects, depending on what it has committed to provide for the detector. The subprojects are lead by subproject leaders, who have been elected among the people working for the specific subproject. The subproject leaders are not necessarily of CERN staff\(^{20}\) and they are ultimately responsible for the subproject besides they own work.

The decision-making is de-centralized to the appropriate level in question. Since the institutes are responsible for their contribution in the subprojects even the top management has very little if any direct formal authority. Because there are many institutes involved on every level, the decisions are taken collectively. For this reason, a huge number of meetings have been needed in the course of the past years. Such collective decision-making takes naturally time but on the other hand, the problems are solved immediately and everyone is kept informed. There have been many working groups and committees for special subjects and areas, some of them working for several years, some only for a short while. The efficient communication is essential, not only for the work proceeding but it serves also other, social functions (Morrison 1978, Tuertscher 2008, 9).

Two levels can be distinguished in the organization; the policy making and the execution levels, as demanded in the MoU (ATLAS Collaboration 1998, Annex 5.3.) The Plenary Meeting and the Collaboration Board are policy making bodies, whereas the EB and the management are executive actors, taking care that the decisions are implemented. The organization can be partly compared to state governmental structures but also many for-profit organizations, such as companies. The Executive Board can be seen as a government for a state or as a board (of directors) of a company. The Collaboration Board as a representative body is comparable to a parliament, whereas the Plenary Meeting is like a General Assembly of a company or the ecclesia in the ancient Athens.

\(^{20}\) The word “staff” is used for the people employed by CERN, regardless of for which unit or experiment they work for. Other members of personnel accredited to work at CERN are called “users” or “visitors”, and they are not subject to the CERN pension funds, health care and other benefits reserved for the staff.
ATLAS is a gigantic project, lasting for many years to come. Inside it there are a countless number of smaller projects: those of participating institutes and small ad-hoc projects which are to solve emergent problems with the best possible people available. When looking at ATLAS as project, four levels of projects can be distinguished. The first level is ATLAS in its entity, as a structured “super-project”. The other level consists of sub-detector structures. The third level includes the related institute projects, which they coordinate by themselves both at CERN and in their home countries. The fourth level is an ad-hoc level where there are no prearranged structures but on which the problems are dealt in an ad-hoc manner as they appear and by the most suitable people for each task.

4.3.2 Management and Leadership

ATLAS is about to shift to the operating phase the need for management and organization changes. For the last ten years, the focus has been in coordinating resources, producing needed components and materials, obtaining the workforce and so on. As the detector is finally completed and ready to use, the main new challenges from the organizational point of view concern data taking and analysis, which are not uncomplicated questions either. The organization has been modified according to a document, namely “The ATLAS Operation Model for the Data-Taking Phase at the LHC” (Giannotti & Stapnes 2005). The work is no more so hardware-oriented (one would say concrete) and dependent on everyone's contribution. Instead, the data analysis is of more competitive nature and the expected remarkable findings can only be made by a smaller group of experts. The question of possible competition is acknowledged and the need for persistent cooperation is emphasized by the management and also on the collaboration level.

It is also worth to note that there is no difference between scientific and organizational management and leadership in ATLAS. The managers and leaders (or coordinators, as they are called) are in their positions as they are recognized physicists and because of their personal capabilities. They are elected (or, for the deputy spokesmen, approved) by the Collaboration Board. Candidates for the sub-projects leaders and other positions are nominated by institutes and elected democratically (one vote for one institute). The same applies on the all levels of the organization.
4.3.3 Public Funding

CERN is funded by the member states whereas in ATLAS the financing is mainly gathered from three sources: from national science-funding agencies, CERN and the participating institutes. The collaboration members participate in the project in three ways: by contributing part of the detector hardware or software, paying their share of the common budget and by providing workforce for the collaboration. The costs are shared fairly taking into account the available laboratory resources of each member, which often means that participants coming from rich countries contribute more than those coming from the poorer countries.

The institutes get their funding mostly from national public funding agencies in their countries. A remarkable part of financial resources of ATLAS come from thus directly or indirectly from public sources. Nevertheless, ATLAS is neither a part of public management nor it provides public services. It stands somewhere in between the two and can thus be classified as half-public or “parastatal” organization (Santalainen 2006, 56; Santalainen & al. 2007). In terms of organizational goals ATLAS is comparable to public sector organizations: it is not aiming at economic success.

Public funding is not always an easy issue as there may be different interests involved, such as national and political aims. It is estimated that CERN has been able to stay quite independent in regard to its member states and fulfill its own scientific aims and ambitions (Krige 1991). ATLAS and also CERN are remarkably independent compared to for example the EU-led Galileo project\(^2\), which is a global satellite radio navigation system under construction.

Both projects claim for scientific and technological knowledge, but their approach is completely different. In ATLAS, the detector was first designed and the organization put in place later on, as for the Galileo everything else seems to be taken into account and planned

\(^{2}\text{Galileo is taken here only as an example due to comparable organization complexity. The relations between scientific and political aims in international science-technology institutions and projects would undoubtedly deserve a research of their own. Given the limits of the time and material available, we restrained ourselves from studying this aspect in depth in the present study.}\)
beforehand, except from the satellite itself. As there are significant political, technological and economic interests involved, the project is much more complicated in terms of stakeholders, their rules and regulations, as well as services provided and relations with the private sector (Brocklebank & al. 2000).

ATLAS and Galileo are not, however, fully comparable since the domain of the former is basic research, whereas the latter possess also commercial values and security aspects. However, it gives us an idea how complicated an international project can be, if there is a multitude of interests and competing values\textsuperscript{22}.

CERN has a long history of being run and managed by scientists themselves whereas some others for example European Space Research Organization ESRO, later the European Space Agency ESA, settled on the management by engineers and finally imported management knowledge from the US (Johnson 1999). CERN is somehow comparable to universities managed by academics, even though at universities a part of managerial tasks are taken care by career managers. The CERN tradition of academics as managers applies also in ATLAS, as the management is manned by physicists and not by career managers coming from outside the organization.

\subsection*{4.3.4 Information Sharing}
A part of trust is distributing information and free information flow as well inside the ATLAS organization as outside it. In ATLAS the amount of time used for communication may be bigger than in many organizations, as there are a lot of meetings and one may deal with hundreds of relevant e-mails per a day.

The effective information sharing is essential for the project progressing and as the members of the collaboration are dispersed all over the world. On the other hand, it possesses a problem of IPRs. As the work is mainly done in a cooperative way in groups, it is not always clear who proposed the original idea and whom to give the credit for the

\textsuperscript{22} It is possible that ATLAS is seen to have value itself, whereas Galileo is used as a pretext for other (political) aims. Therefore it could possibly even be claimed that for European countries, Galileo is not so much a joint scientific or even technological project as a forum for politics (and political horse-trading) among others.
invention. Protecting intellectual property by patents is not an established tradition at CERN. The first patent was obtained only in 1996 and the total number of patent families is so far about 30 (Huuse 2008). IPR issues were not treated in the interviews, but it is possible that the relatively small number of patents could cause from the research traditions at CERN or in HEP and that it would be an indication of the “first things first” –mentality.

A way of communicating is a weekly publication on the web, the ATLAS e-news, which is edited by professional journalists. It informs what is going on, presents personal profiles of people working for ATLAS and popularizes science by answering questions the readers may pose. The e-news is comparable to small local newspapers that tell the news of a town; it is a common forum for the whole community.

4.3.5 ATLAS and CMS

ATLAS and CMS are the two big general-purpose experiments at CERN and have a lot in common. They are thus somehow comparable so we will take here a short look on CMS, too.

The goal is the same: finding the Higgs boson but even though, the techniques they use are different\(^23\). The foci of the other experiments are slightly different. ATLAS is somehow bigger in size whereas CMS is heavier in weight. Both are about of the same size and in the number of people involved. Their organizations are quite alike on paper, both having similar collaboration structure with several subprojects, a collaboration board, an executive board, spokesmen with their deputies, technical and resource coordinators.

\(^23\) Without taking a deeper look into the technical and physical details, a significant difference is the structure of the detectors: ATLAS has two different kinds of magnetic devices, a toroid and a solenoid ones, whereas CMS has only a solenoid magnet. The magnets are also seen in the detector names: Compact Myon Solenoid for CMS and A Toroidal LHC ApparatuS for ATLAS.
5 Methods and Methodology

This study concerns only one organization, the ATLAS experiment at CERN. Typically, the tool for studying single objects such as ATLAS is based on case study research. It is about studying an individual event, restricted entity or a person by using diverse information, acquired by different methods. The question used to study, describe and explain cases are mainly “why” and “how” (Yin 1994, 5–13). Thus, case study does not concern methodology but the subject of the research (Stake 2005, 443). It is not easily characterized as a coherent form of research but rather an approach that merges elements of different theoretic approaches. The obvious strength in using case study approach is that it describes one case in more depth. The downside is that information provided by case study may not be general enough to capture well other cases. (Stark & Torrance 2004, 33–34).

For the research method multiple strategies with combined operations may be used. This means that the study combines different methods and research material to obtain as reliable information as possible. The research method in the present study comprises a survey of literature on strategy, analyzing official documents of the ATLAS Collaboration and the CERN organization as well as interviewing some of the key people in ATLAS. The research is carried out at CERN which gives an opportunity to exploit not only previous literature and research but also observations made on the spot. The research in ATLAS consists of familiarizing ourselves with documents provided by ATLAS, such as minutes of meetings and reports of different kind, and discussing with people.

The study is partly descriptive as it was believed that in order to understand the organization in case and enhance the validity one must get known with the environment, the field of HEP and its characteristics. Only after that any assumptions and conclusions can be made. We assume thus that the theories we use and the subject of this study are socially constructed and thus, relative, not representing the absolute truth. In social sciences, the knowledge is accepted, not confirmed as the truth (Kuusela 1996)
5.1 Material

This study is based first and foremost on the research literature, written documents and interviews. The author of this study has used her personal observations only as a support. These observations have not, however, been made in such an intensive and systematic way that the present study could be classified as ethnographic work. The ethnographic methods are thus only used partly and to support the information gained by other methods.

The study exploits also perceptions and observations gained during our half a year stay at CERN. We have had an opportunity to meet people working for ATLAS there, and discuss with them in several unstructured occasions, such as during coffee breaks. These encounters have provided us a lot of tacit knowledge about the organization and enhanced our understanding about it.

These observations exploit at some point the methods of ethnography. There are many ways to define ethnography but briefly, it is a research method that is based on intensive observations made “in field” i.e. at the organization that is the subject of a study (Lappalainen 2007, 9–10; Tolonen & Palmu 2007, 89). An ethnographer uses vast quantities of time in the organization in case and utilizes both observations made in a rich variety of occasions and other material to form his/hers conclusion (Alvesson & Deetz 2000, 75).

5.2 Interviews

For the purpose of the present study, we conducted seven semi-structured interviews of the ATLAS management and project leaders. A semi-structured interview poses more or less the same questions to all interviewees, but not necessarily always in the same order. It can sometimes be called also as theme-centered interview. (Saaranen-Kauppinen & Puuniekka 2006, 6.3.2.-6.3.3.).

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24 By CERN is meant here the physical place, where the ATLAS experiment is hosted. The Collaboration and its researchers are thus dispersed all over the world but use CERN as their base.
The aim of the interviews was to get good and reliable information about the ATLAS organization and its functioning. A starting point for this study was the observed absence of a codified strategy in the ATLAS organization, that is to say, there was no specific document to be found on it. An organization of this size and complexity could be assumed to have such a document. However, there has obviously not been a need for a codified strategy as evident by the fact that the organization has successfully managed to complete one of the biggest apparatus ever built.

The interviewees could have been asked why the ATLAS Collaboration has no need for a codified strategy, or whether they would have needed one. Instead a different approach was chosen. Strategy and structure are supposed to be interdependent (e.g. Chandler 1962, Fayol 1949, Mintzberg 1979, Sveiby 1990) and the ideological orientation of the organization affects the organization structure (Harrison 2000). The following explanation was the foundation of the different approach:

The organization structure of ATLAS is more or less given. There are three main factors determining the structure: 1) the form of collaboration between independent home institutes 2) other is the detector structure and the most important, 3) the need for effective problem-solving.

Work and responsibility must be shared fairly between the collaboration members and they must be guaranteed enough power. The structure must also be flexible in a sense that new institutes are welcomed and thus, it must be possible to easily integrate them into the collaboration. The subprojects for their part have so far been quite independent within the overall project. They are formed according to the detector structure in a way that each subproject was responsible for a given sub-detector. These in turn are more or less independent devices within the experiment, although closely interdependent of each other. The effective problem-solving is essential as the problems must be solved as soon as possible and on the appropriate organization level, that is, as close as possible.
These two aspects are thus boundary conditions limiting the organization structuring. It is of course possible that there would be a better way to structure such an organization in order to get the best possible results. However, as collaborations in particle physics have a long tradition, the way to arrange them has been shaped according to the needs of the field\textsuperscript{25}.

Therefore, we assumed that instead of talking about absent strategy it would be more fruitful to find out what the organization structure is, how the people are and how they are working within the organization. By the information gained we might then find factors explaining the strategy absence. The idea was thus to talk about practical issues such as motivation factors, decision-making and relations within and outside the organization instead of applying more abstract concepts. These are subjects the interviewees have been dealing with every day for years, so their experiences were crucial.

None of the persons contacted for an interview refused and all respondents showed interest in the study. We noticed soon after the first interviews that the experiences and thus the answers were quite alike. As the period spent at CERN was quite busy for the collaboration members due to the detector being in the final stages, the material gathered was considered to be adequate. The number of interviews was finally seven, including persons from the management, the CB and the subprojects, thus from different levels and viewpoints of the organization.

The interviews lasted from 45 minutes up to bit over an hour. Except for one interview made by telephone the conversations were carried out in person at CERN. Six interviews were conducted in English and one in Finnish, which was then translated into English by the author. All interviews were also recorded.

In general, the interviews followed the same structure but the order of the questions and the used words were not always exactly the same. There were 4–5 wider themes: the big

\textsuperscript{25} It can naturally be questioned whether good traditions are better than proven theories based on the knowledge of administration and management experts.
picture of the ATLAS, the people working for it, organizational issues and decision-making and questions concerning one’s position and work. When introducing a new theme, we usually posed first a wider question and went then into the details with partly planned, partly spontaneous questions, depending on the answer. The themes were nor always strictly adhered to, since answers were sometimes broad and touched several themes.

The interviewees reacted to and understood the questions very differently. Some of them answered only strictly to the posed question whereas the others treated question more widely and discuss also other issues related to the subject. Sometimes the interviewees seemed not to be quite sure whether their answers were useful and even asked this. It may indicate a clash of research cultures: in physics, the questions as well as the answers are supposed to be exact and there are no alternative choices. For social scientists, there is no right or wrong answer in that sense, and the usefulness of the material can be judged only afterwards.

The structure of the interviews is presented in the Appendix 1 and results, including quotes from the interviewees are presented in the next chapter.
6 Relations between Strategy, Structure and People

ATLAS can not be classified into any of ten strategy schools defined by Mintzberg, but at least elements of learning and cultural schools can be found. ATLAS works “now and here” and the decisions are taken when needed. This is not to say that the big picture of the whole project has been clear long before the construction began, as well as the rough design of the detector.

All the characteristics of adhocracy as defined by Mintzberg can be found in ATLAS, which is not surprising if taking into account the nature of its activities. The environment is complex, the machines and systems to be built are mostly unique and realizing them requires both taking advantage of existing knowledge and innovative problem-solution. Expertise of several domains is needed and institutional and organizational boarders are crossed when necessary in order to solve a problem. Because of the complexity and unpredictability of the project in its entirety, the organization is highly self-organizing and self-healing.

According to Mintzberg, an emergent strategy works well in adhocracies. Taking this into account, the absence of strategy in ATLAS is not surprising. If ATLAS were a for-profit organization providing goods it might well make strategic decisions according to the current situation and its strategy would thus be classified as emerging strategy.

The classic strategy theories state that the strategy shapes the structure (Chandler 1962). According to the literature presented before, in this traditional model the strategy is first formed (usually by the management or special strategists). Next, the strategy is executed: the organization structure is (re-)organized according to the strategy and the strategy is communicated via the structure to the whole organization. The process is thus linear, as presented in the Figure 1.

![Figure 1. The traditional linear forming and execution of a strategy](image-url)
According to the gained experiences and feedback, the strategy can be adjusted or reformulated, so the process keeps on evolving. If the strategy is radically changed then the process starts from the beginning.

In ATLAS, this model does not seem to apply. There is no common collaboration strategy document in ATLAS, but in spite of that, the organization functions well and the collaboration has been capable of building one of the biggest devices ever built, using several one-of-the kind solutions and technologies. This is an enormous achievement by itself, but it is even more so when taking into account that all this has been done by a network of scientists in which most of decision are made by discussion and democratic process.

In discussions with the ATLAS management one can draw a conclusion that nobody really knows how ATLAS works. This has been also bewildering for visitors coming from outside the community. The decisions are taken collectively in committees, boards and meetings of every kind. ATLAS is thus a democratic project, in which the progress is made by collective decision making and informing each other, as well as documentation and accessibility of information via computer networks, regardless of time and physical location.

As we found in the literature review, the organization structure is arranged in a certain way to realize the organization’s goals and to optimize the effectiveness and efficacy. According to Fayol and his successors, the structure defines for example the hierarchy, the areas of responsibility of people, and the lines of command.

Only few “traditional” organizational characteristics apply well in ATLAS. It does not have a strategy document in which the structure is defined. The structure itself is quite ambiguous. We assume thus that in ATLAS the strategy, the organization structure and the people are not in a linear relationship but interconnected. The strategy and the structure are interdependent and strategy is not communicated to the personnel via the structure but
because of the people, the strategy and structure are such as they are. Our assumption is presented in the Figure 2.

![Diagram of interdependency of strategy, structure and people in the ATLAS organization](image)

Figure 2. Interdependency of strategy, structure and people in the ATLAS organization

In the next chapter we will have a closer look to the people working for the ATLAS experiment and try to find out, how they possible may explain the nonhierarchical structure of ATLAS. We believe that this would also explain the missing strategy as well as the success of the organization.

### 6.1 Cavemen in a Foreign Legion or Diplomats in an Anthill

The analysis and results of the conducted interviews will be provided here. In order to better understand the organization and to present parts of authentic parts some direct quotes by interviewees will be included. It is believed that this give the reader better idea of rich material that was gained by the interviews.

The interviews will be referred by quoting the informants that are named by P$n$ ($n=1..7$). $P$ refers to the person and $n$ to the ordinal number of the interview. As we were interested in the information and not the discourse the quotes include mainly the message, not the way it was spoken. In this study we also dismissed the sex of the interviewees and therefore the informants are referred here only as persons.

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26 Assuming that the reality is socially constructed, the way how an interviewee responds (such as using sighs, pauses, registers of languages) is as important as what (s)he actually says or which word (s)he uses. An interview is an interactive process in which the interviewer and the interviewee create together new and common meanings. (Hirsjärvi & Hurme 2006).
6.1.1 Individuals in the Multicultural Collective

People working for ATLAS are mainly researchers, scientists, engineers and technical staff. They are not only experts on their field but also characterized by the working environment, the science and namely, the ATLAS experiment. In general, people working in ATLAS were described by the informants to be “nice human beings”, intelligent, some being even geniuses; open minded as well as highly motivated and committed to their work. They are driven by the curiosity, motivated by the scientific results and have all in common the will to get the experiment work. People in ATLAS were thought to be not so different from the other researchers of the field.

There is a stereotypic image of a physicist, being more or less isolated in his own world, not communicating a lot with others. Such stereotypes are remote from the people working for ATLAS. However talented and bright a person may be, the social skills are needed since the work is of highly collaborative nature. It is important that one has ideas, (s)he is capable and willing to express them and also listen and respect the others and their ideas. The two most important characteristics that are needed for succeeding in working there can be summarized to be 1) scientific competence and 2) willingness and capability to cooperate with others.

P4: “A picture of physicist sitting in their office and not talking to anybody is totally contrary; we sit in the meetings and talk, talk, talk, you have to speak all the time. There are a lot of communications. And then, it's of course very open-minded. We work on a daily basis with people from China, USA, Egypt, Japan, Russia where ever, many places”

ATLAS is known for being democratic, and an effort is made to get people involved in the decision-making process. There are meetings on every level of the organization, to the extent that some may question whether they all are needed:
P1: “If you asked the present CERN Director General, he would say that they (in ATLAS) are crazy, that they should work instead of meeting. But -- the meetings have their functions, and a function is also to keep the collaboration together. Everybody must have the same information. It is not good not only for the work but also for the social aspect.”

For the ATLAS people, the meetings are not a waste of time, let alone inefficient. Having meetings constantly takes definitely time, but it is also effective in terms of work as everybody gets the same information at the same time. The problems are solved right away, sometimes even instantly, by a heuristic method hard to explain even by the participants.

P1: “You go into a meeting, you have a number of problems, you come out of the meeting and by magic they are solved. The combination of ideas associated with the existing knowledge - - it is the intelligence of everybody coming together.”

One of the informants interviewed compared the working and problem solution in ATLAS to brains and neuron networks. The problems are not handled hierarchically but there are always several parallel possibilities and entries. The meetings are important for problem-solution, as open questions can be discussed collectively to find the best solutions. As the project is complex and changes and delays of the other groups or subprojects may affect on one’s own work, it is necessary to have a wider perspective.

P4: It’s an obligation to have a bigger overview. I have to know little about much more that it would be good to know.

The nature of scientific work in ATLAS is highly collective, whereas people are “great personalities” as described by one informant. This could be a potential source of contradictions if everyone stuck up to their own opinions. The solution which applies also in ATLAS, is keeping balance between personal freedom and individuality and collectivity.
One point of view considering the internationality of ATLAS community is cultural. People come from different institutes and working cultures, originate from different countries and communicate in English as a lingua franca, which is not the mother tongue for most. How do they work aside of each other in such a melting pot? Does this variety of cultures affect on the work and if it does, in which way?

Some respondents noticed that some people have stronger knowledge of English whereas others may face some problems because of their English skills, but generally speaking the language is not an issue. Depending on the situation and persons also other languages are used, but the “official” common language is still English.

Cultural differences were admitted in several answers, but they were thought to be more enriching than disturbing elements, with which one must just live. For example, some nationalities were said to be more precise or to comply with the rules better than others. As one learns to know how certain nationalities work, this could be taken into account and the personal approach can be adapted correspondingly beforehand. But as reminded by some interviewees, personalities and individual capacities count far more than nationality (see also Morrison 1978, 14).

Working with people having different backgrounds was seen as richness. Having coworkers and friends across the cultural boundaries and from all over the world increases mutual understanding of different cultures. Regardless of the background the people have the common dream and goal.

P6: (P)erhaps I'm naive optimistic but I like to think of ATLAS as helping the peace in the sense that we have the common goal which is completely peaceful and we try to understand each other's characters [...] and given that we have the common goal it's easier...

The particle physicists would probably be excellent diplomats as they are used to solve very complex problems in highly multicultural environment. CERN is probably one of the very
few places in the world where for example Iranians, Americans and Russians may gather around the same table to solve nuclear physics problems.

The differences between nationalities may also be seen outside ATLAS. Some interviewees remarked that in some countries science is more appreciated than in others, which may ease communication with a national science community, funding agencies and public. Cultural differences may also reportedly be seen when cooperating with companies, in their way of communication and quality of products and services. As this point of view was not more studied, any conclusions about this can not be made. It should be kept in mind that these differences may rather originate from the organization cultures of companies and values of the people working for them than their nationality or country of origin.

6.1.2 Motivation and Commitment

The motivation in science is not linked with money, but with the scientific results. As for the ATLAS case, the expectations towards it are high, as this will be the first time when such energies will ever be used. Besides the predicted findings, most importantly the Higgs boson and super symmetry, there might be something unpredictable. A great part of motivation is possibly linked to the fact that the research made in ATLAS is something none has ever done or seen before.

P1: “I think that people are motivated at the first place by the potential, you want to go somewhere you can see something nobody has ever seen, that nobody ever knows. It is the fundamental science.

P5: “What motivates, well it is the science mainly. You really have to have some kind of faith in what you do, you work long days and so on, it is the science that motivates. - - Money is not first, it is the scientific success first.”

The common will to get the detector to work is closely linked to the motivation. As could be assumed by the literature we studied before experts such as scientists are usually
motivated by other factors than money. This is clearly seen also in ATLAS: the motivation is linked first and foremost with the scientific results.

As mentioned by the two quoted interviewees, two things can be distinguished: the fundamentality and the faith in what you do. Another informant put it like this:

P4: “(T)he nice thing in High Energy Physics is that it is a thing you really fundamentally believe in. As you come and work in here, you somehow go into very fundamental question of mankind... I mean, you come to the Big Bang, you come to the smallest particles, this is motivating, it really is. - - thinking that I'll do a little, little piece for that, that mankind knows more now... - - you know, it is the knowledge which motivates me. It is a bit like elitism... I don’t know where it comes from.”

Doing basic research is the basis for knowledge, which has had and still has a major impact on civilization. Curiosity and willingness to know have pushed the Europeans throughout the centuries: to explore the world and the human being, to discover the secrets of the Nature and the Universe, and to invent and build technical machines. Science and the art have flourished in the Europe though they have been faced also resistance. Being a little piece of this development is an intriguing idea and motivating factor at least for some scientists. The previous interviewee continues:

P4: “(T)he European culture, at least (in my country) has always been like - - everything which is theoretic or very fundamental (is important)... I think the arts go to the same direction; something which has not the direct use in industry or in the economics, has a certain value - - they not produce that much money but it is still good, I think it's very important. On top of that, our culture, civilization, is pretty well now and it has developed in such a way because we have always been very curious, we have always wanted to know more than we know - -
And we are living from that. For me, it is somehow the continuation of that. To have a feeling that you are doing something important."

The informant thus sees the HEP and his own work as a part of continuum both of the science and European culture and civilization. He compares the HEP and science in general with art: in modern society, both are classified as non-productive fields in the economic sense, but they are still essential for the humanity and civilization. Thus, there is an idea of producing common good as a motivating factor. The physics is also very fundamental as science. Everybody knows Einstein and Newton, and being in a way their descendent in science or at least continuing their work is an intriguing idea.

Apart from the common scientific curiosity and being part of making history, there are also other personal factors for motivation. CERN is an intriguing environment for a person who is interested in learning new and willing to stretch one’s knowledge outside the own field. There is a lot of expertise of numerous fields and areas involved in the project.

P1: “(They are motivated by) a context of this type of research, interesting technology development - - new ways to do things, new challenges. - - I could not have invented electronics and I'm not good at developing a pixel detector but I can do the combination work. So, you have a multifaceted environment.”

P6: I think it's a privilege, it's very rewarding that I have access to a lot of information, it's very interesting.

Hardly anyone chooses a scientific or academic career for economic reasons and in many countries the salaries in the universities are not competitive. The money should not be underestimated either. The CERN staff positions are limited but compared to the most universities, the salaries are good and additional benefits are offered. It must be kept in mind that most of people in ATLAS are employed by their home institutes, which can not offer salaries or benefits comparable to CERN. Instead, working at CERN has a lot of other
benefits and tempting factors. Even if it does not always offer career prospects, the work itself is rewarding.

P2: “For me, coming to CERN was not an academic choice, my work is so different than back at home... - - But instead, this is the best work I could ever get.”

Experiments may take up to 20 years, almost a half of one’s career. Being involved with a successful experiment is seen as a good reference. However, as the contracts are often made for only a limited period of time, it is hard to make plans for the future. This concerns people who have not a stable position either in their home institutes or at CERN. It is a great worry especially for people with families and spouses as there are work, school and day care issues to be arranged for the whole family. Combining the passion in science with family engagements is not always easy.

From the other point of view, mobility enhances the new fresh ideas and transferring the knowledge between experiments and institutes. If one has a permanent position, there is a risk that the work becomes routine and innovativeness disappears. Again, if one has not a stable position, (s)he often tries to avoid risks and concentrate on the current work, which also limits the new ideas. New ideas are essential for new innovations and theories. People in ATLAS are specialists, but continuous learning and innovating is a need.

6.1.3 Cooperation

The need of close cooperation within ATLAS is evident and we will now have a closer look on it. Besides the cooperation among colleagues in ATLAS, the experiment is in close connection with outside actors. We will treat some of them, namely CERN, the other LHC experiments and the industry.

Ad hoc problem solving teams get mainly organized thanks to the personal relations and researchers’ knowledge about each others’ expertise areas and experiences. Trust is an essential element in forming these groups. The ad-hoc problems are usually situated into
“no man’s land”; they may concern for example consolidation of different parts of the detector or searching for a solution to a question that has to be solved but of which none is responsible for.

Being involved for many years for the common project naturally affects on people’s identity and this is clearly seen in ATLAS as stated also Knorr–Cetina (1998).

P7: “Naturally as you work hard for many years for the experiment you identify with it. I do think this is absolutely the same for the other experiments, bigger or smaller.”

Inside the collaboration, the ATLAS people are proud of being part of the project:

P5: “They are quite proud to be involved this, to be able to build such a complicated detector.”

When working intensively for several years for a common aim and dream, it is not surprising that relations among the colleagues get often on a personal level and colleagues become friends with whom one spent time also outside the work. Having current and previous coworkers all over the world provides one “a place to stay overnight everywhere”.

P3: “As you work at CERN, you become friends with your colleagues - - we do things also with families - - And a good thing is, that you have friends around the world you can visit.”

Meeting people personally both at CERN and around the world was emphasized by many interviewees. The office doors of the top management are always open to everyone willing to see them and several times a day people pop in to discuss their problems. The members of the management also travel in meetings and conferences around the world.
Both CERN and ATLAS managements face challenges in their relationships. In the course of years, CERN has evolved into a quite a complex and hierarchical management system and it has established certain structures and patterns. ATLAS as an organization is relatively young and people are used to creative solutions, innovativeness and organizational flexibility. In some cases there is a conflict of interests and the ATLAS management having a “double hat” is not an optimal solution, as they must take also CERN into account. Being paid by CERN may hinder ATLAS management in some situations where more independency would be appreciated.

For example, some of the informants feel that ATLAS does not profit from its host laboratory as much as it could or should do. ATLAS is charged for many services that used to be taken care by CERN. Some interviewees mentioned also that CERN is not providing training or support for the leadership positions.

P7: “CERN of course has limited resources and our requests of resources are not always satisfied. So there is more of tension in terms of resources. It's also the collaborations are to some extent, independent from CERN, so clearly, from time to time, means that one is not of the same opinion of CERN. Most of the time, of course, but it always comes back to the resources.”

Interestingly, when asked about factors most hindering the work of the interviewees, CERN was mentioned several times. It is possible that there is also a clash of cultures of two organizations of different age.

When asking about the inter-experimental relations CMS as competing sister experiment was mentioned as the closest one. We will have a closer look on it in the “Competition” part. Relations with other experiments are rather formal. News from them are mainly transmitted by CERN and its structures. Undoubtedly the interpersonal relations do not respect the collaboration boundaries information is shared via informal ways, personal relations between researchers working for the different collaborations.
P7: “Well, of course we share some issues, like computing and of course scheduling of the machine. They can be even more conflict or problematic; of course being smaller brothers... smaller brothers are shouting louder and making more noise.”

ATLAS and CMS are the biggest experiments with the highest expectations so it is natural that they get most of the attention also from CERN. This may naturally cause jealousy in other experiments. There is not much formal interaction apart from the common meetings organized by CERN, but the informal connections work like with the CMS people. Sometimes the collaborations may have shared interests but even in that case they might be discussed more or less informally for example over a coffee.

According to many interviewees, the personality of the spokesman does have an impact on the collaboration. For example, it affects the way the problems are solved and how the information is shared. The democratic and consensus-seeking way of decision-making was seen to be linked with the humble and diplomatic personality of the current spokesman. Some of the interviewees noted that everyone would be happy if the possible Nobel Prize was appointed to him.

**Cooperation with the industry**
ATLAS is built for basic research, but as it is built in close cooperation with the industry, its impact on the outside world is not negligible. In the construction phase, industry partners provided components and parts for ATLAS. This cooperation was mainly run by the participating institutes being responsible to deliver their given contribution, for example a specific device for the detector. As the universities are often publicly-funded, there were national interests involved about how the money allocated to them should be used. In some cases national funding was conditional; it may, for example, presume that acquisitions must be provided by domestic companies. Therefore, a free competitive bidding could not always take place. In some cases the national interests were satisfied by in-kind
contributions, meaning that a member institute pays its share by providing material or work force.

The relations with industry are two-fold: first, industry provides materials and components to ATLAS, and second, ATLAS and its member institutes cooperate with companies. As ATLAS needs are unique concerning e.g. temperature, radiation and mechanical precision, CERN and the experiments readily cooperate with companies given the production volumes in question. This is beneficial for both parties; the companies gain knowledge and a good reference, and the science partner get the components exactly as specified. Not every company had qualified the strict requirements and there had been some disappointments too, but in general the companies were seen as partners and indispensable for building ATLAS.

*P4: “(At CERN), money is spent again into European industry; it helps also the European industry. For me, it is investment in high technology, not only basic research. I think most people catch this idea.”*

The industry partners gain experience and if everything goes well, good references. The public resources spent on the basic research are also paid back to the tax-payers via the science-industry cooperation. The latter is more closely involved in society, for example by employing people, paying taxes and also refining the results of basic research to commercial products.

### 6.1.4 Competition

In business organizations and quartile capitalism, the competition is often hard. Not even good results are a guarantee against layoffs. Helping a colleague may be profitable to some extent, but it may turn against oneself in promotions, compensations or when the company is obliged to denounce people. In some cases it may even be profitable to act against a colleague behind his or hers back. If the atmosphere of the organization is suchlike, there is little trust but a lot of wasted energy and thus, the result can not be the best possible. It is too easy to compromise common goal for a personal benefit.
In ATLAS there is not such an immediate risk, as there is little competition in that sense. People are mostly employed by different institutes and get their salaries from various sources. However, as CERN faced financial setbacks some years ago and the spending was cut, this affected also ATLAS. Even though the work itself did not disappear, many limited-term contracts of the CERN staff could not be renewed and some people were obliged to find work elsewhere. This subject was not directly treated in the interviews but it came up in some of them, mainly when talking about personal relations and motivation.

According to informants the unexpected cuts naturally influenced people and created bitterness. But they did not affect the project in a way that someone would have abandoned his work ahead of time or disturbed or complicated the work of others. Again, the goal of the completed detector and love in science and professional pride were seen more important and any personal disappointment was put aside.

Achieving aims is seldom as critical as it is for ATLAS in which every subsystem and machine simply must work, otherwise the detector as a whole won’t perform. In most of other organizations the need for success is not as total. However, this totality of success or failure is quite similar in cases dealing with the safety and the risk of serious accidents, where the compromises are intolerable. This applies for example construction of airplanes, buildings or hospital equipment. Besides, there is the personal motivation driven by curiosity. In the business world there is not such a common collective spur. For these reasons, the goal-setting and commitment is seldom as collective as it is in ATLAS.

P1: “Take for example (name of a big multinational company). They would do this for hundred years and they would not still arrive to the same!”

The cooperation and the lack of competition are also probably due to the close personal relations and the mutual trust. Differing from many other organizations, the cooperation between people and between institutes is quite safe and thus, profitable. Helping others is worthwhile as its progresses the whole project and as offering help to others, one can rely
on the help of others if needed. As the success of the entire project is dependent on functioning of all the areas, the non-cooperative persons would fall outside the supporting network, if said vulgarly, kicked out.

Even though there hardly is any competition between persons, there is some competition between institutes, trying to get their components or appliances approved into the final detector. This competition does not preclude the members of different institutes to cooperate or discuss the problem in question. This ensures the multiplicity of points of view which makes it more probable that all the relevant questions will be taken into account.

There is also some competition with the sister experiment CMS though the competition is not very serious. It may be described by a joke initiated by CMS and widely known in the HEP community: the Higgs has already been first seen at CMS as Peter Higgs, after whom the Higgs boson has been named, recently visited the experiment first. But success of both experiments is beneficial for all, as the results of the one must in every case be validated by the other. It is thus in everyone’s interest that both detectors work as they are supposed to.

P4: *It would be a catastrophe if one of the two big experiments would not work, any discovery of any of the two will need some kind of confirmation - - But of course for us, ATLAS is always ahead and CMS will just confirm our findings! (laughs) But we must get the two experiments to work properly.*

However, it is possible that having “a competitor” aside may give additional spur to people, enhance the collaboration cohesion and community spirit in both side of the common office building.

The competition in ATLAS in general can thus be seen as a positive phenomenon that exhorts the experiments, institute groups and individuals to do their best and thus ensure that the chosen solutions are the best possible. The positive competition is not a destructive but an encouraging force that processes the solutions to be the best possible.
6.1.5 Conclusions about the People and the Structure in ATLAS

The absence of an outspoken strategy and codified strategy document in ATLAS is due to the fact that the organization does not need such a document. The ultimate goal and the way to get there are so obvious to everyone that writing them down as a strategy document would almost look silly.

The ultimate goal of getting the Nobel Prize can be classified as a vision of the ATLAS Collaboration. In the ATLAS case, the question of mandate is not that essential because the organization is not really a public entity. However, because the funding does come outside of CERN, there can be seen “signs of mandate”, as the funding is ATLAS-specific. The question of the mandate would become relevant only if the organization suddenly used money for something that had absolutely nothing to do with the project itself.

There is a common ideological background and assumption in ATLAS, namely the will to achieve scientific breakthroughs and, as a means to achieve this, to build a functioning particle detector.

It can be stated that ATLAS is functioning very well, even if according to related research literature, it should not. In practice, the researchers and research groups develop and construct together a giant machine, without a codified strategy and hierarchical control. As stated before, the goals are clear in everybody’s mind: to build together a giant device, find the boson and, if lucky, win the Nobel for it.

We claim that the functioning of the organization of this size without an outspoken strategy is due to the people working for ATLAS and especially to two characteristics: motivation and personal capacities. The people are not driven by external factors but by their curiosity, interest in science and willingness to be involved in something none has ever done or seen before. LHC with its experiments will not only shape the future of the HEP field and its research areas. It will also drastically enhance our knowledge about the Universe in some years.
The factors that motivate the ATLAS people are both the easiest and the most complicate. As the people are working because they want to know more, the work is not a burden but a pleasure and people are willing to contribute as much as possible. On the other hand, this kind of inner motivation can not be improved by money or any other promotional action. They may help to the some point but not forever.

The personal capacities are the other contributing factor to the strategy absence in ATLAS. Most people are intelligent and smart, highly educated, used to solve complex problems and willing to cooperate with others in order to attain the shared goal. They are capable to take responsibility on their own work and to work on their own initiative innovatively without surveillance or tight organizational control.

None can obtain the goal alone so cooperation is indispensable, as well as any actions and mechanisms to facilitate it. An essential prerequisite for efficacious cooperation is mutual trust (Knorr-Cetina 1998). The cooperation does not limit to the members of the own experiment but the information is shared and colleagues helped across the organizational boundaries. Due to these characteristics of the people there is no need for strict control and hierarchical organization structure. In ATLAS, the people with their motivation and capabilities make possible the flat and nonhierarchical structure. It would not work if people were not willing and capable to take responsibility for their own work. The free-riders are taken care by the social control but even more by the self-control (Knorr-Cetina 1998). The self-organization in ATLAS is illustrated for example by voluntariness to accomplish tasks that need to be done even if one was not directly responsible for them.

The organization can be very self-organizing and thus flexible as long as some prerequisites have been taken into account. First, the organization must support effective problem-solving. This includes the possibility to come back to any issue or parameter if needed. Second, to ensure the effective problem-solving, the information must be available for every member of the organization all over the world at any time.
The decision-making system and low hierarchy characterize the organization structure of ATLAS. The literature showed that democratic decision-making process serves also other functions than formal act of taking decisions. One could claim that in ATLAS the decisions itself are not as important as the process preceding them: reviewing, discussing, justifying and convincing the colleagues (Tuertscher 2008). The freedom on the every level of the organization is crucial for the project success, as the decisions must be done as close to their subjects and the problems must be solved where they appear. A hierarchical decision making structure with several stages the organization would soon be paralyzed. If a part of the project quits functioning, the whole system will stop at some point. Therefore the organization is kept as flat as possible without any hierarchy that might complicate the work.

The organizational structures such as numerous boards, committees and the importance of meetings of every kind, support self-orientation. The formal and informal structures are more to facilitate coordination as well as information flow and its free circulation than to control people. Control can be understood either as a positive or as a negative phenomenon. The positive control is to keep leaders and management but also the co-workers aware of how the project is progressing, the possible problems and adequate resource allocation. Negative control can be understood as encumbering employees and adhering to rules, regulations, hierarchies or formal processes even though they hinder innovation or even the tasks to be performed. In the ATLAS case the control is understood in its positive form.

A peculiar thing in ATLAS and in other HEP collaborations is a high degree of democracy involved in the decision-making. In principle, all the collaboration members are encouraged to participate in discussions and decision-making. In this study, we did not observe this in practice for example by attending meetings. However, previous researches (Knorr-Cetina 1998), as well as the interviews we conducted support the assumption that this is the case in practice, too Taking into account the amount of money involved in the project and the diversification of inputs the members can devote to it, it is interesting that even in the Collaboration Board all institute members are equal and possess one vote per institute.
Even more intriguing is that the funding agencies of the institutes back at home accept this arrangement. One could assume that the big contributors would claim for share of power in function of allocated resources.

We assume that in ATLAS the classical strategy theories emphasizing the causality between strategy and organization structure do not apply. We call this phenomenon as an application gap of the strategy theories. In ATLAS the organization structure and tacit strategy are interdependent; neither shapes the other. There is no need for strategy in ATLAS as all the members of the organization have the subordinate goal in their mind. In addition to being common and shared, the goal has the following characteristics: 1) everyone’s contribution is needed to attain it, and 2) the requirements for success are extreme. The detector must work perfectly. It is not enough that only 99% of components work properly if the missing 1% paralyzes the whole detector. The quality needs are thus exceptional compared to almost any other organization.

Our first research question was why ATLAS does not need a clearly identifiable collaboration strategy. We can now answer the question by concluding that the absence of an outspoken strategy in ATLAS is due to the high motivation and capacities of the people working for ATLAS, as well as to the common goal they share.

We can also note that our first hypothesis about ATLAS being characterized first and foremost by characteristics of scientific organization is proved, as compared to ordinary business or administrative organizations, ATLAS really is an oddball. Besides scientific organization, the characteristics of expert organization describe ATLAS very well. However, the scientific knowledge is the most dominating factor and the primary source of motivation of the people working for it.

The idea of the relation between organization structure and characteristics of the people brings us to discuss about the third part of the triangle presented before, namely the strategy in ATLAS.
6.2 Tacit Strategy

Even though ATLAS does not have a codified strategy or a written strategy document we claim that it possess a tacit strategy. It is not spelled out but still exists, being so obvious to everyone that it does not need to be proclaimed. Therefore, thinking and analyzing the organizational or strategy matters is not that relevant in ATLAS. As everyone knows what to do and are capable to find out themselves how to do it, there is no need to waste time in the obvious issues and attempts of communicating them to the whole community.

There can also be seen “first things first” – mentality: the detector must be built and it is the primary concern of everyone. Everything that is not essential in terms of the detector building project could have been neglected. On the other hand, “if it works, don’t fix it”: why to worry about issues that could perhaps be organized better if things are functioning satisfactorily and are not threatening the success of the whole project.

The tacit strategy can be seen built into the fundamental documents such as the Memorandum of Understanding (MoU) and Technical Design Report (TDR). The first one defines the collaboration structure, institutes involved and other organizational matters and the latter provides a detailed description of the detector. In both documents, one can find decisions that can be classified as strategic, such as defining the organizational structures and technical outlines. Compared to the closest (and perhaps the only) possible example, the sister experiment CMS, there are differences in these issues. A fundamental difference is the structure of the detector and the magnets used in it.

This is a kind of ideal situation in terms of strategy execution, as everyone on every level of the organization is committed to work for the common goal and willing to stretch his/her contribution if needed. Thanks to this, the ATLAS management does not have to worry about defining the organization’s goal or strategy, neither about motivation or commitment to achieve the goals. The research and literature about strategy deals a lot with these questions. In ATLAS, they are implicitly solved. To some extent, these questions have been discussed in the research of mission-based and absent strategies.
We claim that many things described as ideal in the organizational and strategy theories are intuitively made right in ATLAS. Several problems of “real world” such as mutual competition and lack of motivation are absents, as the capacities of people the structures of the organization do not support these features. They are thus negligible in ATLAS, which is therefore an ideal organization from many points of view. The people working for it are motivated, capable to work on their own initiative; they know what they must do – and do it.

This lengthy discussion serves as answer to the other questions posed: How the ATLAS organization structure can explain the apparent absence of a codified strategy and its apparent efficacy. The second hypothesis, namely “there is no specific need to codify or spell out a strategy for ATLAS as the people involved are self-motivated and their activities are conducted by a shared common goal” was also proved to be true and valid.
7 Discussion

ATLAS is all at once an open and anonym community. It is open in a sense that the collaboration is willing to embrace new participating institutes and researchers. Inside the collaboration, the information is shared for all the members and lot of it is also freely accessible to outsiders. The hierarchy is kept as low as possible. The decision-making on all levels is highly democratic and based on discussion and free flow of ideas and information. Everyone may be involved and will be heard.

The closest examples, to which ATLAS could be compared, are a cavemen society or an anthill. It can be seen as a cavemen society because the common rules are quite simple and consequential though outspoken. Everyone must contribute their best and help the others otherwise one will be frozen out or pacified. These actions are more of symbolic sense; in general people know how to behave as they live within the community for years.

Despite the openness and democracy involved, ATLAS is also anonymous. Like in the Foreign Legion, one is judged by the local norms in a local context, no matter who you are or what have you done. Only the present counts. This is applicable also in ATLAS: there are researchers who are very famous and respected back at their home institute or even worldwide, but do not particularly stand up inside ATLAS. Vice versa, even if respected and honored in ATLAS, some researchers are “persona non-grati” back at their home institutes: no-one special, even overlooked. In ATLAS, one is rated by one’s capability to work in collaboration’s favor, not by his or hers status at the home institute. The position and reputation in ATLAS organization must thus be gained by the other participants; they are not given for free.

The metaphor of an anthill is useful here, as both an anthill and ATLAS are working well and people perform their tasks even though it is hard to understand and explain how they actually do them. Against all the assumptions and theories, they simply get the job done.

ATLAS can also be described as a creative, self-organizing chaos or anarchy which however has a strong inner logic and order. Ideally, the freedom and the responsibility go
hand in hand, even though (or because of) there is not an up-down hierarchy. As people work for different institutes, the questions related to control, guidance and responsibility are often vague.

If a technical project of the size of the ATLAS detector was realized in the private sector, i.e. by commercial companies, the project would highly possibly emerge and be organized in a different way.

First, even very much smaller projects do not just emerge based on discussions with persons who are not in top management of a company. As we found in the literature review, the very first initiative to start a new experiment is often taken by a handful of researchers. These founding fathers of the experiments may well be just researchers, not necessarily the heads of the institutes or persons occupying suchlike positions.

Second, cooperation initiatives are usually based on legally binding agreements, whereas in ATLAS the most important convention is the Memorandum of Understanding, in which itself it is stated that the agreement is not legally binding. Hardly anywhere else such amounts of money could be involved and transferred, basing on such apparently loose agreement. Whereas companies resort to legal services and big companies have their own legal departments, there is not a person having a law degree in ATLAS. When needed, the Collaboration exploits the CERN legal services, but this seldom occurs. Even the written agreements are mainly based on mutual trust, being interpreted as gentlemen’s agreements.

Third, in ATLAS there are a lot more stakeholders than in any company as the organization is a collaboration composed of almost two hundred independent institutions with their funding agencies, governmental actors and other national stakeholders. Taking into account opinions of everybody and reconciling factions is often more complicated than in a company, whose main objective is to keep customers or (ideally and) owners satisfied.

Fourth, there is only one unchangeable goal to which everyone is committed in ATLAS. There is no need for fundamental reorientations or strategy changes. ATLAS is like a train
in that it keeps on going on its rails irrespective of who is driving it, in which order the cars are placed or what happens inside them. The speed and outside conditions may vary, but the real problems will appear only if the rails are out of order or the source of power disappears. However, if the machinery is well maintained, the journey will be easier.

Fifth, because of the collaboration form and multiplicity of stakeholders, the decision-making can not be based on authority and linear orders. Instead, in ATLAS as in many other HEP experiments, the decision-making is in its other extreme: highly democratized process in which anyone can get involved. The equality exists both among institutes and people: the students and professors have the same rights to talk and be heard, and the small and poor institutes, as well as leading universities, have one vote each. The criterion that matters is the scientific capability. The funding and cost-sharing could be described as social-democratic as every institute participates depending on its available resources and possibilities.

Sixth, the openness involved in the ATLAS project is notable. For most commercial companies doing R&D there is always a question about intellectual rights and protecting innovations from the competitors. As for ATLAS, the knowledge is widely shared. The free flow of information is intended and encouraged, and because of the collective decision-making and problem solving systems, the information sharing is also inevitable. Apart from individuals, information is also shared among the institutes and with the industry partners.

Taking all this into account we can conclude that few traditional characteristics of organizations apply on ATLAS. In the next chapter, we will present the conclusions of this study.
8 Conclusions

The question we posed at the beginning was: why does not ATLAS need a codified collaboration strategy, given of the size and the complexity of the project. It was found that even though there is not a codified strategy in a form of a document, there is a very strong tacit strategy which is shaped by the technical and organizational founding documents. The tacit strategy is so obvious to everyone that writing it down would not change much.

This is due to the fact that people working for ATLAS are highly motivated and committed to their work as a result of their passion in science and willingness to know more, create new knowledge and be part of a unique scientific project. Being involved in such a project and working in inspiring environment with highly talented people from different disciplines and from all over the world is satisfying itself for the ATLAS people. Many general problems, related to organization and management are solved implicitly because of the high motivation of the people in ATLAS.

The other questions posed were: how can the ATLAS organization be characterized and how can it explain the absence of strategy and the apparent efficacy. We found that ATLAS is first and foremost a scientific organization. It is also very international, parastatal expert organization, which works in adhocratic, highly self-organizing way. Both the capabilities of the people and organizational structure support this self-organization and involvement of all the people. The characteristics of the organization and its people mentioned above are thus the key for the success of the organization.

8.1 Validity and Reliability of This Study

Given the time and scope of this study there is certain framework that sets limitations for a study like this. There is a vast amount of relevant viewpoints that must have been left out. It is impossible to say whether the choices made were appropriate or not.

The posed research questions and hypotheses could well have been formed differently. They could have been richer, more innovative and more ambitious. Also the framework could have been more unambiguous and concentrate on one field without mixing several
disciplines. The strategy concept could have been discussed more in depth, as well as the strategy absence.

The academic inexperience of the author debilitates the study as well as non-native use of English. The use of English includes a risk of misunderstandings both concerning the literature and interviews. Concerning the interviews it must also taken into account that in most cases neither interviewee nor interviewer were not native English speakers and thus their expression may have been limited compared to the use of mother tongue. These factors could have been impact on the interviews and their reliability. The questions could have been formed otherwise and it is not sure whether they were right and relevant concerning the subject of the study.

Concerning the interviews, it is always possible that even though the discussions with the respondents were tried to be kept on general level, there could have been hidden motives that affected on the answers.

It must be kept in mind that interpretations are always subjective. People experience, understand and interpret things differently and it is highly possible that something is not understood right or in a way it was meant to.

Finally, it comes always to the subjectivity: the assumptions, statements, claims and conclusions made and presented in this study are viewed by one person. It is admitted that the author of this study do not possess the capabilities and knowledge that can be gained only by doing research and sometimes learned by a hard way.

Taking into account both the function of this study and the limitations described above this study can be taken as a small address to the current strategy discussion. However, the results are interesting and to enhance our knowledge about the subject the future studies could take place. Some propositions for the future studies is presented in the following discussion.
8.2 Possible Future Studies

The building phase of ATLAS is now completed successfully, and the operational phase will pose new challenges to the organization. This will open new research questions also for organizational and management researchers. The following paragraphs will suggest some possibilities for further studies, namely, doing a study of ATLAS from the point of view of organizational ecology, comparing the ATLAS and CMS organizations and studying the effect of the spokesperson on the HEP collaboration.

This research used the metaphor of an anthill to describe ATLAS; it would be interesting to analyze ATLAS from the point of view of ecology of organizations or social ecology, however taking into account the restrictions of these theories (Schumpeter 1951, 57–58; George 2002). At this point, we’ll leave it for future studies.

The multiculturalism aspect of ATLAS would deserve a study of its own since in this study the question was not treated in depth due to limited scope and time.

Because CMS is probably the most similar organization to ATLAS, it would be interesting to compare the two from organizational point of view. A deep comparison of ATLAS and CMS would be interesting as this would reveal the best practices of organizing these kinds of projects. It would also provide information with which some generalizations about this kind of organizations could possibly be done. Given the time and the scope of the present study will be noted and the question left to the possible further studies.

It was also mentioned that the organization culture CMS and ATLAS may reflect the personalities of their spokesmen. A comparative study about the correlation between the personality of the spokesman and the organization culture would therefore be interesting.

The problem in studies concerning ATLAS, as well as case studies in general, is their limited ability to be generalized. Because ATLAS and CMS highly resemble each other, comparing them might give more reliable results.
Due to the special conditions regarding the environment and people, the HEP collaborations can be considered exceptional organizations and their ability to be used as generalizations outside the field is highly questionable. They may however provide useful information if we handle them as ideals that have become real and thus, examples from which we can learn something new.
9 References


**Others:**
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ANNEX 1. An example of interview outline with ATLAS management

The questions were varied and additional questions asked according to the answers of the respondent, available time and interest showed by the respondent. These factors affected also on the order of the questions. The questions were tried to be formed more politely whenever possible and not posed as directly as showed below.

- Name, position, what you do in ATLAS
- Briefly describe how did you get involved to ATLAS

- The big picture of the ATLAS experiment?
- What do people outside the Collaboration think about it? Inside and outside the high energy physics community (for example financing institutes, home institutes, public)?
- How the collaboration and the project are different from or similar to previous and ongoing experiments?
- How are the social, personal and organizational relations between ATLAS and CERN and between ATLAS and the other experiments?
- Do UA1 and UA2 still affect on ATLAS, for example in terms of personal relations and contacts?
- How would you describe people working for ATLAS?
- What are the factors that motivate them?
- What are the relations between money, scientific success and (personal) honour?
- Are people interested in their career after ATLAS?
- Do the different cultural backgrounds of the people affect on the work?
- How about using English which is not the native language for all?
- How is ATLAS organization working, both in terms of relations between institutes and day-to-day basis?
- How would you describe the decision making and information transfer in ATLAS?
- What kind of problems (other than technical) have you faced in your position?
- What are the factors facilitating your work? How about the factors that complicate it?
- Please describe the cooperation between ATLAS and companies.
- How do you feel about outsourcing and cooperation with companies? What kind of problems if any there have been concerning this cooperation?